

# Module Handbook Master of Science Meteorology (M.Sc.)

SPO 2015

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KIT DEPARTMENT OF PHYSICS



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## 1 Introduction to the Study Guide

This module handbook is the relevant document describing the structure and the contents of the Master's degree program in Meteorology, and thus provides helpful information and guidance for the studies. The degree program and its subjects and modules are described in detail, thus providing the necessary information for planning an interdisciplinary course of studies tailored to each student's personal interests and needs.

The first section Study Guide specifies the organization of the degree program and further formalities in addition to the general regulations for the Study and Examination.

A key function of the module handbook is the collection of module descriptions (Section 2) and course descriptions (Section3), which provide information on the requirements and recommendations.

In addition to this module handbook, the university calendar and possibly announcements of the institutes inform about further details, for example, on times and places of lectures and classes.

Please note, that only the German version of the Regulation for the Study and Examination ("Studien- und Prüfungsordnung", SPO) is legally binding. The translated version is for the purpose of information only.

KIT is planning a mix of digital courses and face-to-face formats for the winter semester. In general, we aim to offer significantly more face-to-face formats again in the winter semester 2021/2022. We will make concrete decisions in this regard in July, when the progress and success of the vaccination campaign can be better evaluated and the Baden-Württemberg Ministry of Science has made overarching decisions for the winter semester. In order to have sufficient leeway for possible classroom events under hygienic conditions, KIT has already defined six temporal blocks for events for the winter semester 2021/2022, as before, with event times between 08:00 and 19:30. The larger span will allow breaks of 30 minutes each for effective ventilation and cleaning.

We will make every effort to maintain the quality of teaching, even if there are no or only a few classroom events.

For more information please visit <https://www.kit.edu/kit/english/25911.php?tab=%5B25996%5D#plans-winter%20semester2122>

### 2 Qualification Goals

The graduates of the Master's program in Meteorology know and understand the scientific fundamentals of meteorology and climatology, and have deepened them in the areas of the climate system, atmospheric processes as well as applied and experimental meteorology. This also includes aspects of atmospheric composition and thus of trace gases and aerosols. They have well-founded knowledge of programming techniques, numerical methods, computer simulations and data analysis, and have the ability to explain and at least partly apply complex atmospheric measurements in the laboratory, field and from satellite. They are familiar with mechanisms of the climate system and climate change. They know the relevance of meteorological phenomena such as extreme weather events, air pollution and climate change for society, nature and economy as well as for geoscientific neighboring disciplines, and can discuss and debate them. They also have detailed knowledge in a scientific elective.

Based on the acquired knowledge, the graduates correctly classify facts and thematic areas, and have the ability to solve – or develop approaches to solve – complex problems of the atmospheric and environmental sciences in an analytical-theoretical, computer-based or experimental way. They have the ability to deduce relationships from measured or modeled data, to formulate models, to derive predictions and to concretely test them, and thus to verify or falsify them. In addition, they can apply meteorological knowledge to research-related questions and are able to solve technical problems using the methods of the subject, also employing computer programs.

The graduates furthermore have sound methodological skills with regard to clear presentation and structuring of scientific findings and research results in written and spoken texts, and are proficient in didactically appealing presentation techniques. They can work independently and have extensive communication and organizational skills, including sound knowledge of scientific English. They are able to acquire new knowledge and insights as needed and thus to achieve a broadening or deepening of their knowledge. They have learned to reflect on their actions, and to recognize and evaluate the social and ethical aspects of meteorological research and application.

An important part of the education are the principles of good scientific practice, i. e. the maxims of unrestricted conscientiousness and honesty towards oneself and others in the investigation and presentation of scientific facts, unconditional honesty in the attribution of ideas and results to their authors in the past and present, and comprehensive documentation and presentation for the purpose of an open scientific discourse, which includes reexaminations and any kind of objectively justified criticism of ideas, procedures, and results, as well as the right to make bona fide mistakes and to be mistaken.

The distinctiveness of the Master's program in Meteorology compared to other universities lies in the broad range of aspects of meteorology covered as well as the strong research relevance. A successful completion of the Master's program in Meteorology is an excellent foundation for a PhD in Meteorology or in related disciplines, and enables an applied or researching professional activity, i.a. in the field of weather forecasting, earth observation, satellite-based remote sensing and the compilation of environmental reports as well as in atmospheric research institutions and in the insurance and energy industries.

### 3 Field of study structure

Mandatory	
Master Thesis	30 CR
Atmospheric and Climate Processes	24 CR
Applied and Experimental Meteorology	24 CR
Research Work	30 CR
Required Electives	8 CR
Interdisciplinary Qualifications	4 CR

#### 3.1 Master Thesis

**Credits**  
30

This module is intended to provide students with in-depth aspects of scholarly writing and presentation. Building on the results from the Specialization Phase, students further advance their own research project to finally write a Master's Thesis. The written scientific work includes a summary of the state of the literature, presentation of the goals, methods used and the results obtained as well as a discussion of the knowledge gained and the remaining open questions. The students are trained to apply principles of good scientific practice, in particular to document the results, as well as to consistently self-doubt all results, and to present previous work appropriately and honestly.

More information about the modules *Specialization Phase* and *Master's Thesis* is provided in the Guidelines to Master's Thesis in section 7.

Mandatory	
M-PHYS-100956	Master Thesis 30 CR

#### 3.2 Atmospheric and Climate Processes

**Credits**  
24

Mandatory	
M-PHYS-100951	Components of the Climate System 12 CR
M-PHYS-100952	Atmospheric Processes 12 CR

#### 3.3 Applied and Experimental Meteorology

**Credits**  
24

Mandatory	
M-PHYS-100953	Experimental Meteorology 14 CR
M-PHYS-100954	Applied Meteorology 10 CR

#### 3.4 Research Work

**Credits**  
30

Students carry out an interdisciplinary *Study Project*, for which 30 ECTS are credited. The project prepares students for independent scientific working and writing, and introduces skills in project management. The *Study Project* focuses on the topic of the subsequent *Master's Thesis* and serves as a preparation for the scientific work. In addition to the competence in reading and understanding scientific literature, the students acquire abilities for independent work and critical evaluation of results in the context of the literature, and consolidate their knowledge of the rules of good scientific practice.

Mandatory	
M-PHYS-100955	Specialisation Phase 30 CR



### 3.5 Required Electives

**Credits**  
8

The study can be complemented by electives to individualize the degree program. These could thus be modules from related disciplines such as Physics, Geoecology, Geophysics, Mechanical Engineering, or Applied Geo sciences. Examples of possible *Compulsory Elective Modules* from other disciplines are listed below.

<b>Election block: Compulsory Elective Modules (at least 8 credits)</b>		
M-PHYS-101664	<a href="#">Modern Theoretical Physics for Teacher Students</a>	8 CR
M-PHYS-101707	<a href="#">Modern Theoretical Physics I, Quantum Mechanics I</a>	8 CR
M-BGU-102757	<a href="#">Computer Vision and GIS</a>	9 CR
M-BGU-102758	<a href="#">GIS and Remote Sensing</a>	9 CR
M-BGU-102759	<a href="#">Computer Vision and Remote Sensing</a>	8 CR
M-BGU-102760	<a href="#">GIS and Geo Data Infrastructures</a>	10 CR
M-INFO-102980	<a href="#">Informatics for Meteorology Students</a>	8 CR
M-PHYS-103336	<a href="#">Geophysical analysis of natural hazards</a>	8 CR
M-PHYS-103403	<a href="#">Module Wildcard Electives</a>	8 CR
M-BGU-103398	<a href="#">Geoecology</a>	8 CR
M-BGU-103422	<a href="#">Basics of Estimation Theory and its Application in Geoscience Remote Sensing</a>	8 CR
M-PHYS-101833	<a href="#">Geological Hazards and Risk</a>	8 CR
M-PHYS-104488	<a href="#">Physics of Planetary Atmospheres</a>	10 CR
M-BGU-105095	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate</a>	4 CR
M-BGU-105504	<a href="#">Fluid Mechanics and Turbulence</a> <i>First usage possible from 10/1/2020.</i>	9 CR
M-MATH-100536	<a href="#">Numerical Methods</a> <i>First usage possible from 10/1/2020.</i>	5 CR

### 3.6 Interdisciplinary Qualifications

**Credits**  
4

Apart from scientific qualifications, KIT attaches high importance to transferable skills. These skills of 4 credits shall be part of the Master's Program in Meteorology. Transferable skills may be achieved additively or integratively.

A wide range of interdisciplinary qualifications is offered by

- the [House of Competence \(HOC\)](#)
- the [Sprachenzentrum \(language center\)](#)
- the [Center for Cultural and General Studies \(ZAK\)](#)

With regard to scientific qualification, we recommend courses that train scientific work.

Examples:

- During the specialization phase, the course "The Master's Thesis in Physics, Meteorology and Geophysics (Online)" from the HOC is suitable.
- To get a feeling for the implementation of the guidelines for good scientific practice, the Ilias course "Good Scientific Practice" of the KIT Library and the Writing Lab at the HOC is suitable.

<b>Mandatory</b>		
M-PHYS-102352	<a href="#">Interdisciplinary Qualifications</a>	4 CR

## 4 Program

The master's degree program in Meteorology deepens and extends the essential scientific qualifications obtained in the Bachelor's program in a research-oriented way. Consolidation occurs in the areas of Theoretical Meteorology and Numerical Weather Prediction, Climatology, Remote Sensing and Data Analysis as well as in Atmospheric Chemistry and Aerosols, while extensions take place in the area of Applied Meteorology. A comprehensive practical course familiarizes the graduates with methods of modern atmospheric measurements in the laboratory and field. With the completion of the Master's thesis, the graduates have demonstrated that they are capable of applying scientific knowledge and methods to independently solve complex research problems. In addition, they acquired detailed skills in an elective from a wide range of other natural sciences.

**Graphic Course Program M.Sc. Meteorology (SPO 2015)**

Semester	Credit-points	Atmosphären- und Klimaprozesse (Atmosphere and Climate Processes)	Angewandte und Experimentelle Meteorologie (Applied and Experimental Meteorology)	Wahlpflicht-fach (Elective)	Wissenschaftliches Arbeiten (Research Work)	Masterarbeit (Master's Thesis)
1 (WS)	30 3 Examinations	Components of the Climate System 12 ECTS		Elective 1 & Elective 2 at least 8 ECTS		
		Atmospheric Processes 12 ECTS				
2 (SS)	31 3 Examinations		Experimental Meteorology 14 ECTS			
			Applied Meteorology 10 ECTS			
3 (WS)	29				Specialization Phase: Scientific Concept Development 30 ECTS	
4 (SS)	32					Master's Thesis 30 ECTS
	120*	24	24	8	30	30

\* In addition to the compulsory modules mentioned here, interdisciplinary qualifications amounting to **4 credit points** must be completed. In this example, the Soft Skills are scheduled for semesters 1 and 2. Depending on your choice, additional examinations may be required in the respective semesters.

Course Program of the Masters Course Meteorology. Credits corresponding to the European Credit Transfer System (ECTS).



**Exemplary choice** of subject in the compulsory elective area:

**Module „Fluid Mechanics and Turbulence“ (graded)**

WS (1st semester): Choice between:

- Flow Measurement Techniques (3 CP, oral exam, approx. 30 min.) and
- Environmental Aerodynamics (3 CP, oral exam, approx. 30 min.)

SS (2nd semester): Choice between:

- Advanced Fluid Mechanics (6 CP, written exam, 90 min.) and
- Fluid Mechanics of Turbulent Flows (6 CP, oral exam, approx. 45 min.)

In the event of a clash of dates with selected compulsory courses, students always have the option of postponing attendance of the elective compulsory modules until the third or fourth semester. It is recommended that the planning be done together with the study advisor for the MSc Meteorology during a consultation.

## 5 Excerpts from the Regulation for the Study and Examination (SPO 2015)

### 5.1 Regular Period of Study, Organization of Study, Credits (§3, SPO)

- (1) The regular period of study shall be four semesters.
- (2) The curriculum of the program is divided into subjects, the subjects into modules, and the modules are divided into courses. The subjects and their scopes are defined in Article 19. Details are outlined in the module manual.
- (3) The workload envisaged for passing courses and modules is expressed in credits. The criteria for assigning credits correspond to the European Credit Transfer System (ECTS). One credit corresponds to a workload of about 30 hours. Usually, the credits shall be distributed equally over the semesters.
- (4) The coursework and examinations required for the successful completion of the study are measured in credits and amount to a total of 120 credits.
- (5) Upon prior announcement, the courses may also be offered in English.

### 5.2 Module Examinations, Coursework and Assessments (§4, SPO)

- (1) The master's examination shall consist of module examinations. Module examinations shall consist of one or several controls of success ("Erfolgskontrollen"). Controls of success shall consist of coursework ("Studienleistungen") and assessments ("Prüfungsleistungen").
- (2) Assessments are:
  - Written examinations,
  - oral examinations, or
  - examinations of another type.
- (3) Coursework shall be written, oral, or practical work that is usually accomplished by students simultaneously to the taught courses. The master's examination must not be completed by a coursework.
- (4) At least 70% of the module examinations shall be graded.
- (5) In case of complementary contents, module examinations of several modules may be combined (par. 2, nos. 1-3).

### 5.3 Registration for and Admission to Module Examinations and Courses (§5, SPO)

- (1) To participate in module examinations, students shall register online on the Students Portal for the corresponding controls of success. In exceptional cases, registration can be made in writing to the Students Office or another institution authorized by the latter. For controls of success, registration deadlines may be specified by the examiners. Registration of the master's thesis is outlined in the module manual.

To get help with the Campus System visit <https://www.sle.kit.edu/imstudium/videotutorials-campus.php> (currently available only in German language) or ask the *student counseling* via [Mail](#).
- (2) For admission to an examination in an elective module, students shall submit – together with their registration for the examination – a binding declaration relating to their choice of the module and its assignment to a subject prior to the first examination in this module. At the request of the student to the examination committee, the choice or assignment can be changed later. If an examination procedure in a module has already started, the choice of elective or assignment to a subject can only be changed after its completion.
- (3) Admission to a control of success shall be granted to students, who
  - are enrolled in the Master's Program in Meteorology at KIT; with the admission of students on leave being limited to examinations, and to students, who
  - can prove that they meet the requirements for admission to a control of success outlined in the module manual and

- can prove that their entitlement to an examination in the Master's Program in Meteorology has not been lost.
- (4) According to Article 30, par. 5, LHG (Landeshochschulgesetz), admission to individual mandatory courses may be restricted. The examiner shall decide on the selection of students, who have registered in due time before the deadline given by the examiner, taking into account the study progress made by these students and taking into consideration Article 13, par. 1, clauses 1 and 2, if the surplus of registrations cannot be reduced by other or additional courses. In the case of identical study progress, further criteria shall be specified by the KIT departments. The result shall be announced to the students in due time.
  - (5) Admission shall be refused, if the conditions outlined in pars. 3 and 4 are not fulfilled. Admission may be refused, if a control of success that was required for admission to this Master's Program was already passed in a KIT bachelor's program. This shall not apply to premature master's examinations ("Mastervorzug"). Admission to these shall be approved explicitly according to clause 1.

#### 5.4 Execution of Controls of Success (§6, SPO)

- (1) Controls of success shall be performed simultaneously to the taught courses, usually while conveying the contents of the individual modules or shortly afterwards.
- (2) The type of control of success (Article 4, par. 2, nos. 1 – 3, par. 3) shall be specified by the examiner of the respective course depending on the contents of the course and teaching objectives of the module. The type of controls of success, their frequency, sequence, weighting, and the determination of the module grade, if applicable, shall be announced in the module manual six weeks prior to the start of the lecturing period at the latest. The examiner and student may change the type of examination and the examination language later on. In the former case, Article 4, par. 4 has to be observed. When organizing examinations, the needs of students with a disability or chronic disease shall be considered according to Article 13, par. 1. Article 13, par. 1, clauses 3 and 4 shall apply accordingly.
- (3) In case of an unreasonably high examination workload, a written examination may also be passed orally or an oral examination may also be passed in writing. This modification shall be announced six weeks prior to the examination at the latest.
- (4) In case of courses in the English language (Article 3, par. 5), the corresponding controls of success can be executed in this language. Article 6, par. 2 shall apply accordingly.
- (5) Written examinations (Article 4, par. 2, no. 1) shall usually be evaluated by an examiner according to Article 17, pars. 2-4. If an evaluation is made by several examiners, the grade shall be the arithmetic mean of the individual evaluations. If the arithmetic mean does not correspond to any of the grade levels defined in Article 7, par. 2, cl. 2, the grade shall be rounded to the next higher or lower grade level. In case of equal distance to the next higher and lower levels, the grade shall be rounded to the next higher grade level. The evaluation procedure shall not exceed six weeks. Written examinations shall last at least 60 and not more than 300 minutes.
- (6) Oral examinations (Article 4, par. 2, no. 2) shall be performed and evaluated as group or individual examinations by several examiners (examining board) or by one examiner in the presence of an assessor. Prior to determining the grade, the examiner shall consult the other examiners of the examining board. Oral examinations shall usually last at least 15 minutes and not more than 60 minutes per student.

Major details and results of the *oral examination* shall be minuted. The result of the examination shall be announced to the student directly after the oral examination.

Students who intend to take the same examination in a later semester shall be admitted to oral examinations as an observer depending on the space available and upon approval of the examinee. They shall not be admitted to the consultation of the examining board and the announcement of the examination results.

- (7) For *examinations of another type*, (Article 4, par. 2, no. 3), appropriate deadlines and submission dates shall be specified. Proper description of the task and adequate documentation shall ensure that the examination passed can be credited to the student. Major details and results of the control of success shall be minuted.

During *oral examinations of another type*, an assessor shall be present in addition to the examiner, who shall also sign the minutes together with the examiner.

Theses or papers to be written for *an examination of another type* shall be provided with the following declaration:

“Ich versichere wahrheitsgemäß, die Arbeit selbstständig angefertigt, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde.”

„I herewith declare that the present thesis/paper is original work written by me alone and that I have indicated completely and precisely all aids used as well as all citations, whether changed or unchanged, of other theses and publications.”

If the thesis/paper does not contain this declaration, it shall not be accepted. Major details and results of such a control of success shall be minuted.

### **5.5 Controls of Success by a Multiple-Choice Test (§6a, SPO)**

It is outlined in the module manual whether and to what extent controls of success can be made by a multiple-choice test.

### **5.6 Repetition of Examinations, Ultimate Failure (§8, SPO)**

- (1) Students may repeat once a written examination that has not been passed (Article 4, par. 2, no. 1). In case a repeated written examination is given the grade of “nicht ausreichend” (5.0, failed), an oral re-examination shall take place soon after the date of the failed examination. In this case, the grade of this examination may not be better than “ausreichend” (4.0, sufficient).
- (2) Students may repeat once an oral examination that has not been passed (Article 4, par. 2, no. 2).
- (3) Repeated examinations according to paragraphs 1 and 2 shall correspond to the first examination in terms of contents, scope, and type (oral or written). At request, exceptions may be approved by the responsible examination committee.
- (4) Examinations of another type (Article 4, par. 2, no. 3) can be repeated once.
- (5) Coursework can be repeated several times.
- (6) An examination shall ultimately not be passed, if the oral re-examination according to par. 1 was evaluated with the grade of “nicht ausreichend” (5.0, failed). The examination also shall ultimately not be passed, if the oral examination according to par. 2 or the examination of another type according to par. 4 was evaluated twice with the grade of “nicht bestanden” (failed).
- (7) The module shall ultimately not be passed, if an examination required for passing the module is ultimately not passed.
- (8) A second repetition of the same examination according to Article 4, par. 2 shall be possible in exceptional cases at the request of the student only (“Antrag auf Zweitwiederholung” – application for a second repetition). As a rule, the application shall be submitted in writing to the examination committee within two months after announcement of the grade.

The examination committee shall decide on the first application of a student for a second repetition. If the examination committee dismisses the application, a member of the Presidential Committee shall decide. Upon comment of the examination committee, a member of the Presidential Committee shall decide on further applications for a second repetition. If the

application is accepted, the second repetition shall take place on the next but one examination date at the latest. Paragraph 1, clauses 2 and 3 shall apply accordingly.

(9) Repetition of a passed examination shall not be permitted.

(10) In case a Master's thesis has been granted the grade "nicht ausreichend" (5.0, failed), it can be repeated once. A second repetition of the Master's thesis shall be excluded.

### **5.7 Loss of the Entitlement to an Examination (§9, SPO)**

In case coursework or an examination required according to the present Regulations for Study and Examination is ultimately not passed or the master's examination, including potential repetitions, is not passed completely by the end of the examination period of the seventh semester, the entitlement to examination in the Master's Program in Meteorology shall expire, unless the student is not responsible for having exceeded the deadline. The decision on extending the deadline and on exceptions from the deadline regulations shall be made by the examination committee taking into account the activities listed in Article 32, par. 6, LHG at the request of the student. This request shall be made in writing usually six weeks prior to the expiry of the deadline.

### **5.8 Deregistration, Absence, Withdrawal (§10, SPO)**

- (1) Students can revoke their registration for *written examinations* until the issue of the examination tasks without having to indicate any reasons (deregistration). Deregistration can be made online on the Students Portal by 12 pm on the day before the examination or in justified exceptional cases with the Students Office during office hours. If the deregistration is addressed to the examiner, the latter shall ensure that the deregistration is documented in the Campus Management System.
- (2) In case of *oral examinations*, deregistration shall be declared to the examiner at least three working days before the date of examination. Withdrawal from an oral examination less than three working days before the date of examination shall be possible under the conditions outlined in par. 5 only. In principle, withdrawal from oral reexaminations in the sense of Article 9, par. 1 shall be possible under the conditions of par. 5 only.
- (3) Withdrawal from *examinations of another type* and from *coursework* shall be subject to the provisions given in the module manual.
- (4) An examination shall be deemed to have been "nicht ausreichend" (5.0, failed), if the student fails to be present at the examination without a good reason or if she/he withdraws from the examination after its start without a good reason. The same shall apply, if the master's thesis is not submitted within the period envisaged, unless the student is not responsible for having exceeded the deadline.
- (5) The reason given for withdrawal after the start of the examination or absence shall be notified immediately, credibly, and in writing to the examination committee. In case of sickness of the student or of a child cared for by the student alone or of a relative in need of care, submission of a medical certificate may be required.

### **5.9 Maternity Leave, Parental Leave, Assumption of Family Obligations (§12, SPO)**

- (1) At the student's request, the maternity protection periods as defined by the Act on the Protection of the Working Mother (Mutterschutzgesetz, MuSchG), as amended, shall be considered. The required evidence shall be enclosed with this request. The maternity protection periods suspend any deadline according to the present examination regulations. The duration of maternity protection shall not be included in the deadline given.
- (2) At request, the deadlines of parental leave shall be considered according to the valid legislation (Bundeselternzeit- und Elternzeitgesetz (Parental Benefit and Parental Leave Act – BEEG)). Four weeks prior to the desired start of the parental leave period at the latest, the student shall inform the examination committee in writing about the time when she/he wishes to be on parental leave. The required evidence shall be enclosed. The examination committee shall then check whether the legal prerequisites would justify an employee's claim for parental leave and inform the student

immediately of the result and the new times of examination. The period of work on the Master's thesis may not be interrupted by parental leave. In this case, the thesis shall be deemed to have not been assigned. After expiry of the parental leave period, the student shall receive a new subject that is to be dealt with within the period defined in Article 14.

- (3) At request, the examination committee shall decide on the flexible handling of examination deadlines according to the provisions of the Act of Baden-Württemberg on Universities and Colleges (LHG), if students have to assume family obligations. Paragraph 2, clauses 4 to 6 shall apply accordingly.

#### 5.10 Students with a Disability or Chronic Disease (§13, SPO)

- (1) When organizing degree programs and examinations, the needs of students with a disability or chronic disease shall be considered. In particular, students with a disability or chronic disease shall be granted preferred access to courses with a limited number of participants and the order for passing certain courses shall be adapted to their needs. According to the Federal Equality Act (Bundesgleichstellungsgesetz, BGG) and Vol. 9 of the Social Code (SGB IX), students are disabled, if their bodily function, mental capacity, or emotional health most probably deviates from the state typical of the age for a period longer than six months and, hence, their participation in social life is impaired. At the request of the student, the examination committee shall decide on the existence of conditions outlined in clauses 2 and 3. The student shall submit the required evidence for this purpose.
- (2) If a student provides evidence of a disability or chronic disease, as a result of which she/he is not able to pass examinations completely or partly within the planned time or in the form envisaged, the examination committee may permit examinations within other time periods or in another form. In particular, disabled students shall be permitted to use the required aids.
- (3) In case students provide evidence of a disability or chronic disease, as a result of which they are not able to attend courses regularly or to pass the required coursework or examinations as outlined in Article 19, the examination committee may permit at the student's request passing of certain coursework and examinations after the expiry of the deadlines given in the present Regulations for Study and Examination.
- (4) Examples of possible compensations of disadvantages:
- Modified form of exams, for instance oral exams instead of written exams, and vice versa
  - Conducting exams in a separate room
  - Allowing necessary utilities and assistance, e.g. sign language interpreter
  - Additional breaks during time-limited exams
  - Extension of the periods between exams

#### 5.11 Master's Thesis (§14, SPO)

The *Master's Thesis* is an independent scientific study and includes the theoretical and/or experimental work on a complex problem. Students deal with the current state of research and apply the expertise and scientific methods acquired during the studies. They can document, discuss and evaluate the obtained results. Furthermore, they can present and defend the essential findings. The topic of the *Master's Thesis* depends on the subject area chosen for the thesis.

- (1) For admission to the master's thesis module, module examinations worth 70 credits must have been passed successfully. In particular, module examination in the subject of "Wissenschaftliches Arbeiten" (Scientific Work) must have been passed successfully. At the request of the student, the examination committee shall decide on exceptions.

**(1a)** 30 credits are assigned to the master's thesis module. It consists of the master's thesis and a presentation. The presentation shall be given four weeks after submission of the master's thesis at the latest.

- (2) The master's thesis topic can only be given out by university teachers ("Hochschullehrer(in)"), habilitated scientists, and leading scientists ("leitende(r) Wissenschaftler(in)") according to Article 14, par. 3, clause 1, KITG. In addition, the examination committee can authorize other examiners to give out the topic according to Article 17, pars. 2-4. The student shall be given the possibility of making proposals for the topic. If the master's thesis is to be written outside of the KIT Department of Physics, the approval of the examination committee shall be required. The master's thesis may also be accepted in the form of group work, if the contribution of the individual student to be evaluated in the examination can be distinguished clearly based on objective criteria and if the requirement outlined in par. 4 is fulfilled. In exceptional cases, the chairperson of the examination committee shall take care of the student receiving a topic for the master's thesis within four weeks after her/his request. In this case, the topic is issued by the chairperson of the examination committee.
- (3) The subject, task, and scope of the master's thesis shall be limited by the supervisor such that it can be handled with the workload outlined in par. 4.
- (4) The master's thesis shall demonstrate that the student is able to deal with a problem of her/his subject area in an independent manner and within a limited period of time using scientific methods. The scope of the master's thesis shall correspond to 30 credits. The maximum duration of work on the thesis shall amount to six months. The subject and task shall be adapted to the scope envisaged. The examination committee shall specify in which languages the master's thesis can be written. At the request of the student, the examiner can permit the master's thesis to be written in a language other than German.
- (5) When submitting the master's thesis, the student shall assure in writing that the thesis is original work by her/him alone and that she/he has used no sources and aids other than indicated, marked all citations in word and content, and observed the Rules of KIT for Safeguarding Good Scientific Practice, as amended. If this declaration is not contained, the thesis will not be accepted.

The wording of the declaration may be:

*"Ich versichere wahrheitsgemäß, die Arbeit selbständig verfasst, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde sowie die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet zu haben."*

*"I herewith declare that the present thesis is original work written by me alone and that I have indicated completely and precisely all aids used as well as all citations, whether changed or unchanged, of other theses and publications, and that I have observed the Rules of KIT for Safeguarding Good Scientific Practice, as amended."*

If the declaration is not true, the master's thesis shall be evaluated "nicht ausreichend" (5.0, failed).

- (6) The time of giving out of the topic of the master's thesis shall be recorded in the files of the examination committee by the supervisor and the student. The time of submission of the master's thesis shall be recorded in the files of the examination committee by the examiner. The student shall be allowed to return the topic of the master's thesis once only within the first month of the period of work on the thesis. At the justified request of the student, the examination committee may extend the time of work on the thesis given in par. 4 by three months at the maximum. If the master's thesis is not submitted in time, it shall be deemed to have been "nicht ausreichend" (failed, 5.0), unless the student is not responsible for this failure.
- (7) The master's thesis shall be evaluated at least by one university teacher ("Hochschullehrer(in)") or leading scientist ("leitende(r) Wissenschaftler(in)") according to Article 14, par. 3, clause 1, KITG and another examiner. Usually, one of the examiners is the person who gave out the thesis topic according to par. 2. In case of deviating evaluations of both persons, the examination committee shall fix the grade of the master's thesis within the limits of the evaluations of both persons. It may also appoint another expert. The evaluation period shall not exceed eight weeks after submission of the master's thesis.



### 5.12 Additional Achievements (§15, SPO)

- (1) Up to 30 further credits may be acquired in courses offered by KIT (additional achievements, "Zusatzleistungen"). Articles 3 and 4 of the examination regulations shall remain unaffected. These additional achievements shall not be considered when calculating the final and module grades. The credits not considered when determining the module grade shall be listed as additional achievements in the transcript of records. At the student's request, additional achievements shall be indicated in the master's certificate and marked as additional achievements. Additional achievements shall be listed with the grades outlined in Article 7.
- (2) The student shall declare a module examination an additional achievement when registering for this examination. At the student's request, allocation of the module can be changed later on.

### 5.13 Transferable Skills (Soft Skills) (§15a, SPO)

Apart from scientific qualifications, KIT attaches high importance to transferable skills. These skills of 4 credits shall be part of the Master's Program in Meteorology. Transferable skills may be achieved additively or integratively.

A wide range of interdisciplinary qualifications is offered by

- the House of Competence (HOC)
- the Sprachenzentrum (language center)
- the Center for Cultural and General Studies (ZAK)

### 5.14 Recognition of Coursework and Examinations as well as of Study Periods (§18, SPO)

- (1) Coursework and examinations completed, as well as study periods passed, in study programs at state or state-recognized universities and universities of cooperative education of the Federal Republic of Germany or at foreign state or state-recognized universities shall be recognized at the request of the student, if the competencies acquired do not differ considerably from the achievements or degrees to be replaced. For this, no schematic comparison, but an overall analysis shall be made. As regards the scope of a coursework to be recognized, the principles of the ECTS shall be applied.
- (2) The student shall submit the documents required for recognition. Students newly enrolled in the Master's Program in Meteorology shall submit the application together with the documents required for recognition within one semester after enrollment. If documents are not available in the German or English language, an officially certified translation may be required. The examination committee shall bear the burden of proving that the application does not meet the recognition requirements.
- (3) If achievements from outside of the KIT are recognized, they are listed as "anerkannt" (recognized) in the certificate. If grades exist, they shall be taken as is in case of comparable grade scales and shall be included in the calculation of module grades and the final grade. In case of incomparable grade systems, the grades can be converted. In the absence of grades, the note "bestanden" (passed) shall be entered.
- (4) When recognizing coursework and examinations passed outside of the Federal Republic of Germany, the equivalence agreements adopted by the Conference of Ministers of Education and the German Rectors' Conference as well as agreements concluded within the framework of university partnerships shall be considered.
- (5) Knowledge and skills acquired outside of the university system shall be recognized, if they are equivalent to the coursework and examinations to be replaced in terms of contents and level and if the institution, where the knowledge and skills were acquired, has a standardized quality assurance system. Recognition may be refused in parts when more than 50% of the university's study program is to be replaced.
- (6) The examination committee (§16, SPO) shall be responsible for recognition. To determine whether a considerable difference in the sense of par. 1 exists, the responsible subject representatives shall be

heard. Depending on the type and scope of coursework and examinations to be recognized, the examination committee shall decide on admission to a higher semester.

The process of recognition is as follows:

#### **In case of a change of the degree programme**

If you want to change from another course of studies to meteorology and climate physics, you can in principle have achievements from the old course of studies recognised by the examination board. Students of **Meteorology and Climate Physics** fill in the form after consulting **apl. Prof. Dr. Andreas Fink (Advisory Service for Meteorology and Climate Physics)**.

#### **In case of a change of university**

Students who continue a bachelor's or master's program in meteorology and climate physics at KIT that they started at another university may have their study and examination achievements recognized. The procedure is the same as for changing the course of study. The excerpt of the student's\* grades and the module handbook of the university from which the student changed to KIT serve as proof.

#### **In case of a stay abroad**

When planning your study abroad, you can select courses in the module handbook of your host university that essentially correspond to the curriculum of the KIT Faculty of Physics.

In the **ERASMUS program**, you fill out a form for an individual study plan, the so-called *Learning Agreement*, before you start your studies abroad. For this purpose, suggest to the examination board which courses and performance assessments (study or examination achievements) of your host university should replace those of KIT. The scope (in credit points) of the course to be recognized must not be significantly smaller, the central contents (according to the module handbook) and the form of examination (written, oral, ...) must be identical, and the degree of difficulty of the performance review must be comparable to or higher than at KIT.

We offer students who plan to study abroad outside the ERASMUS program the agreement of an individual study plan with the KIT faculty (analogous to the ERASMUS Learning Agreement). You can find the form [here](#) (or here as [pdf](#)). Students fill out the ERASMUS *Learning Agreement* or the individual study plan of the KIT faculty together with the above-mentioned student advisory service. After their return, they will then apply for the recognition of their achievements abroad. For this purpose, the usual [form \(pdf\)](#) has to be filled in and submitted to the examination board with supporting documents (e.g. the transcript of records). Study achievements that were not previously agreed upon can also be recognized. Additional achievements cannot be acquired abroad (PrfOrd §15 (1)).

### **5.15 Accomplishments obtained outside of the Higher Education System**

Accomplishments made outside of the higher education system, as for example vocational training, can be accredited if the acquired competences contribute to the qualification goals of the Master's program. Recognition is requested with the respective form of the examination committee.

The examination committee verifies to which extent the acquired knowledge and capabilities can be recognized, and which parts of the program they can replace. At maximum, 50 % of the university education can be replaced. The form for recognition must be submitted to the study advisor, who will transfer it to the examination committee and the "Studierendenservice".

## 6 Modules

### M

## 6.1 Module: Applied Meteorology (Met-AngM2-1) [M-PHYS-100954]

**Responsible:** Prof. Dr. Joaquim José Ginete Werner Pinto

**Organisation:** KIT Department of Physics

**Part of:** [Applied and Experimental Meteorology](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
10	Grade to a tenth	Each summer term	1 term	English	4	5

Mandatory			
T-PHYS-109142	<a href="#">Methods of Data Analysis</a>	0 CR	Ginete Werner Pinto, Knippertz
T-PHYS-109143	<a href="#">Applied Meteorology (Module Exam)</a>	10 CR	Ginete Werner Pinto
Election block: Compulsory Electives Applied Meteorology (between 2 and 3 items)			
T-PHYS-108610	<a href="#">Turbulent Diffusion</a>	0 CR	Hoose, Hoshyaripour
T-PHYS-109141	<a href="#">Energy Meteorology</a>	0 CR	Emeis, Ginete Werner Pinto
T-PHYS-109139	<a href="#">Advanced Numerical Weather Prediction</a>	0 CR	Knippertz

### Competence Certificate

**Prerequisite:** Coursework ("Studienleistung")

For type of Coursework see Course description ("Teilleistungsbeschreibung")

→ successful completion of the prerequisites entitles to exam

**Examination:** Assessment ("Prüfungsleistung")

### T-PHYS-109143 Applied Meteorology (Module Exam)

Oral exam (approx. 60 minutes) in accordance with § 4 (2) No. 2 SPO Master's Meteorology

### Competence Goal

The students can professionally explain essential aspects of application of meteorology and assign them to specific application areas. The students are capable to derive the Impact on air pollution and generating regenerative energy from weather information. They are capable of analyzing meteorological phenomena using statistical and computer-based methods.

### Module grade calculation

Grade of the oral exam.

### Content

This module aims to give students an overview of important applications of meteorology in areas such as weather forecasting and warning, insurance and energy industry, air quality and data analysis. In particular, the module deals with the following aspects:

- **Methods of data analysis** that are widely used in the Geosciences and particularly in meteorology / climate research are presented (e.g., statistical methods, correlation analyzes, least-squares (linear, multi-linear, and nonlinear regression), principal component analysis, Fourier analysis)
- Methods of **numerical weather prediction** (hydrodynamic systems of equations, spectral approximation methods, difference approximation on irregular grids, statistical data assimilation methods, operational aspects of weather forecasting).
- **Energy meteorology** (fundamentals of the energy system, application of meteorological expertise in the energy industry, in particular for the integration of renewable energies wind power, solar energy and hydro power, deepening of individual meteorological aspects of particular relevance)
- Dispersion of atmospheric constituents (relevant trace gases, diurnal cycles of emissions and concentrations, temperature and flow evolution in the lower atmosphere, **turbulent diffusion**, turbulence parameterization, chemical conversion processes, numerical models)

### Recommendation

Basic knowledge in statistics are helpful.

**Workload**

Presence time in lectures, exercises: 90 hours

Preparation / follow-up: 90 hours

Exam preparation: 120 hours

## M

**6.2 Module: Atmospheric Processes (Met-AtPr1-1) [M-PHYS-100952]**

**Responsible:** Prof. Dr. Corinna Hoose  
**Organisation:** KIT Department of Physics  
**Part of:** Atmospheric and Climate Processes

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
12	Grade to a tenth	Each winter term	1 term	English	4	4

Mandatory			
T-PHYS-107694	Cloud Physics	0 CR	Hoose
T-PHYS-107695	Energetics	0 CR	Fink
T-PHYS-108938	Atmospheric Aerosols	0 CR	Möhler
T-PHYS-107696	Atmospheric Radiation	0 CR	Höpfner
T-PHYS-108939	Atmospheric Processes (Module Exam)	12 CR	Hoose

**Competence Certificate**

**Prerequisite:** Coursework ("Studienleistung")

For type of Coursework see Course description ("Teilleistungsbeschreibung")

→ successful completion of the prerequisites entitles to exam

**Examination:** Assessment ("Prüfungsleistung")

**T-PHYS-108939 Atmospheric Processes (Module Exam)**

Oral exam (approx. 60 minutes) in accordance with § 4 (2) No. 2 SPO Master's Meteorology

**Competence Goal**

The students can name essential processes in the atmosphere and explain these using physical and chemical laws. In particular, they are capable of explaining structure and dynamics of different cloud systems and estimating the micro physical processes in clouds or calculating them directly for idealized conditions. In addition, the students are capable of mathematically evaluating the radiation transport in the atmosphere and describe the importance of radiation processes for the structure of the atmosphere, for climate change and for the measurement of different atmospheric variables. They can also explain the chemical structure and the composition of the aerosols in the troposphere and the stratosphere on the basis of the atmospheric physico-chemical processes and transformations. The students know the main aerosol-cloud processes and are familiar with the *Köhler theory* and the classical nucleation theory.

**Module grade calculation**

Grade of the oral exam

**Content**

This module aims to give students an overview of important convey physical and chemical processes in the atmosphere. In particular, it includes:

Cloud Physics (phenomenology, cloud dynamics of stratiform and convective clouds, microphysics of warm and cold clouds, collision and coalescence, primary and secondary ice formation, condensational and depositional growth)

Energetics (mean meridional circulation, stationary and transient eddies; basic forms, budget equations and transport processes of energy in the atmosphere; principle of available potential energy; Lorenz cycle: energy reservoirs and transformation processes, eddy and thermally driven jets (EP flux vectors))

Atmospheric aerosols (gas particle processes (kinetics, diffusion, condensation), aerosol properties (diffusion, coagulation, sedimentation, impaction), Aerosol thermodynamics (chemical potential, solubility, crystallization), aerosol cloud processes (Köhler theory, ice nucleation))

Atmospheric radiation (basic quantities of electromagnetic radiation, atmospheric radiative transfer, boundary conditions, reflection, emission, molecular spectroscopy, line broadening, scattering, optical phenomena, radiation parametrization in atmospheric models, radiation budget, climate change, remote sensing)

**Workload**

Presence time in lectures, exercises: 113 hours

Preparation / follow-up: 87 hours

Exam preparation: 160 hours

## M

## 6.3 Module: Basics of Estimation Theory and its Application in Geoscience Remote Sensing (GSchApplGeoRS) [M-BGU-103422]

**Responsible:** Prof. Dr. Jan Cermak  
Prof. Dr.-Ing. Stefan Hinz

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [Required Electives](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German/English	4	2

Mandatory			
T-BGU-106821	<a href="#">Basics of Estimation Theory, Prerequisite</a> <i>This item will not influence the grade calculation of this parent.</i>	1 CR	Hinz
T-BGU-106633	<a href="#">Data Analysis in Geoscience Remote Sensing Projects, Prerequisite</a> <i>This item will not influence the grade calculation of this parent.</i>	2 CR	Cermak
T-BGU-106822	<a href="#">Basics of Estimation Theory and its Application in Geoscience Remote Sensing</a>	5 CR	Cermak, Hinz

### Competence Certificate

oral exam of about 30 min.

### Competence Goal

Students explain the theoretical basics and important aspects of detection, classification and parameter estimation. They apply the concepts and methods of estimation theory, deformation and statistical analysis to data recorded by geodetic, geophysical or remote sensing systems. An even deeper understanding of the subjects is reached by home and project work. The students process the collected project data and evaluate the obtained results critically. By working self-organized and reflectively the students deepen their knowledge in soft skills, e.g., organization, collaboration and communication.

### Module grade calculation

grade of oral exam

### Prerequisites

none

### Content

Contents of the module include

- an introduction into stochastic modelling (starting with the Bayes-Theorem),
- theoretical models and applied methods of detection of events in signals,
- theoretical models and applied methods of classification of events in signals.
- a variety of methods for parameter estimation, e.g. least-squares estimation, transformation of probability density and integration of a-priori knowledge about parameters and observations,
- an introduction into the different statistical based methods of deformation analysis,
- statistical approaches to the analysis of remote sensing data in a geosciences context.

### Workload

210 h total, thereof 45 h contact hours

## M

**6.4 Module: Components of the Climate System (Met-KKli1-1) [M-PHYS-100951]**

**Responsible:** Prof. Dr. Andreas Fink  
**Organisation:** KIT Department of Physics  
**Part of:** Atmospheric and Climate Processes

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
12	Grade to a tenth	Each winter term	1 term	English	4	6

Mandatory			
T-PHYS-108933	Components of the Climate System (Module Exam)	12 CR	Fink
Election block: Compulsory Electives (between 3 and 5 items)			
T-PHYS-107692	Seminar on IPCC Assessment Report	0 CR	Ginete Werner Pinto, Hoose, Ludwig
T-PHYS-107693	Tropical Meteorology	0 CR	Knippertz
T-PHYS-108928	Climate Modeling & Dynamics with ICON	0 CR	Ginete Werner Pinto, Voigt
T-PHYS-108931	Middle Atmosphere in the Climate System	0 CR	Höpfner, Sinnhuber
T-PHYS-108932	Ocean-Atmosphere Interactions	0 CR	Fink

**Competence Certificate**

**Prerequisite:** Coursework ("Studienleistung")

For type of Coursework see Course description ("Teilleistungsbeschreibung")

→ successful completion of the prerequisites entitles to exam

**Examination:** Assessment ("Prüfungsleistung")

**T-PHYS-108933 Components of the Climate System (Module Exam)**

Oral exam (approx. 60 minutes) in accordance with § 4 (2) No. 2 SPO Master's Meteorology

**Competence Goal**

The students can explain essential components of the climate system and their physical properties. They are capable of explaining causes of climate change competently, present them and discuss them critically. Students can name and explain climate monitoring systems and explain the basic principles of climate models.

The students can designate essential processes in the atmosphere and ocean and explain them with physical and chemical laws. They are able to analyze and interpret climate and weather data on the basis of diagnostic methods. In addition, they can competently present and discuss learned or self-developed scientific findings.

**Module grade calculation**

Grade of the oral exam.

**Content**

This module aims to give students an overview of important components of the climate system, their physical and chemical backgrounds and their temporal and spatial changes.

This includes lectures, course work, computer and modelling classes on individual components of the climate system (e.g. tropics, polar regions, ocean, middle atmosphere) and on climate dynamics and change.

**Recommendation**

Basic knowledge about the climate system is helpful.

**Annotation**

In the module *Components of the climate system* courses (C) are offered with lectures (L) and exercises (2L1E) and lectures without exercises (2L). Registration for this examination is only possible if courseworks have been made in a sufficient amount. There are different ways to do this:

- 2C with 2L1E and 2C with 2L

**Workload**

Presence time in lectures, exercises: 120 hours

Preparation / follow-up: 120 hours

Exam preparation: 120 hours



## M

## 6.5 Module: Computer Vision and GIS [M-BGU-102757]

**Responsible:** Prof. Dr.-Ing. Stefan Hinz  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** Required Electives

<b>Credits</b> 9	<b>Grading scale</b> Grade to a tenth	<b>Recurrence</b> Each winter term	<b>Duration</b> 1 term	<b>Language</b> German/English	<b>Level</b> 4	<b>Version</b> 2
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Mandatory			
T-BGU-101681	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	3 CR	Rösch, Wursthorn
T-BGU-103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite	3 CR	Rösch, Wursthorn
T-BGU-101732	Image Processing and Computer Vision	4 CR	Weidner

**Competence Certificate**

online test, written exam (90 min.), oral exam (30 min.)

**Competence Goal**

Die Studierenden sind mit der Erfassung, Analyse und Präsentation von Daten mit Raumbezug vertraut. Darüber hinaus kennen sie die unterschiedlichen Aspekte geometrischer und topologischer Modellierung und beherrschen die Sachdatenverwaltung.

Die Studierenden verstehen ferner die grundlegenden Prinzipien eines Geoinformationssystems und sind mit der Definition des Raumbezugs vertraut. Sie sind in der Lage, einfache projektbezogene Fragestellungen selbstständig zu bearbeiten. Darüber hinaus können sie ausgewählte Grundlagen der Bildverarbeitung und Computer Vision beschreiben, anwenden und auf andere Anwendungsgebiete übertragen.

**Prerequisites**

None

**Content**

*Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen:* Bezugs- und Koordinatensysteme sowie deren Transformation (z.B. UTM, Gauß-Krüger); Grundlagen der Informatik (z.B. Datenbanken, SQL); Geodatenmodellierung und Erfassung (z.B. GNSS); Normierung und Standardisierung in GIS (z.B. ISO, OGC, WFS, WMS); Einfache Algorithmen (z. B. „Point in Polygon“); Software: Vornehmlich QGIS, ArcGIS, Web-GIS u. a.

*Image Processing and Computer Vision:* This course provides an overview of basic approaches of image processing and computer vision, starting from image filters like linear and non-linear filters, gradient and curvature operators and leading to concepts of object extraction based on point, line and segment extraction and their applications. The module consists of lectures and labs.

**Recommendation**

None

**Workload**

Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen: 180 h gesamt, davon Präsenzzeit 45 h

Image Processing and Computer Vision: 90 h total, thereof 32 h contact hours

## M

**6.6 Module: Computer Vision and Remote Sensing [M-BGU-102759]**

**Responsible:** Prof. Dr. Jan Cermak  
Dr.-Ing. Uwe Weidner

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** Required Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	2 terms	German/English	4	3

Mandatory			
T-BGU-105725	<a href="#">Introduction into Classification Methods of Remote Sensing</a>	4 CR	Weidner
Election block: Computer Vision and Remote Sensing (between 1 and 2 items as well as 4 credits)			
T-BGU-101732	<a href="#">Image Processing and Computer Vision</a>	4 CR	Weidner
T-BGU-106333	<a href="#">Remote Sensing of a Changing Climate, Prerequisite</a>	1 CR	Cermak
T-BGU-106334	<a href="#">Remote Sensing of a Changing Climate, Examination</a>	3 CR	Cermak
T-PHYS-108283	<a href="#">Wildcard</a>	4 CR	
T-PHYS-108284	<a href="#">Wildcard</a>	4 CR	
T-PHYS-108285	<a href="#">Wildcard</a>	4 CR	
T-PHYS-108286	<a href="#">Wildcard</a>	4 CR	

**Competence Certificate**

oral exams

**Competence Goal**

*Einführung in Klassifizierungsverfahren der Fernerkundung (Pflicht):* Studierende können die Grundlagen der Fernerkundung erklären sowie grundlegende Klassifizierungsverfahren benennen, erläutern und selbstständig anwenden.

*Satellite climatology – remote sensing of a changing climate:* Students explain the contribution of remote sensing to the assessment of climate change and its consequences in time and space. They relate how remote sensing assessments help further in understanding of processes driving global change. Students independently choose and apply methods and data sets suited for the analysis of specific aspects of global change.

*Image Processing and Computer Vision:* Students are able to explain the fundamentals of image processing and Computer Vision. They describe the basic approaches and concepts including robust techniques and are able to use their knowledge and transfer it to other fields of applications.

**Module grade calculation**

weighted mean by credit points

**Prerequisites**

none

**Content**

*Einführung in Klassifizierungsverfahren der Fernerkundung:* Die in den Vorlesungen und Übungen behandelten Themen umfassen die Themenbereiche Vorprozessierung und Visualisierung von Fernerkundungsdaten und deren Eigenschaften, grundlegende Klassifizierungsverfahren und Prinzipien der Bewertung der Klassifizierungsgüte sowie Anwendungsbereiche von Klassifizierungen und deren Ergebnisse hinsichtlich Landbedeckung und Landnutzung.

*Satellite climatology – remote sensing of a changing climate:*

- Basics of global change: Mechanisms and patterns
- Remote sensing approaches to analysing patterns of global change:
  - Land and ocean surface
  - Atmosphere
- Remote sensing approaches to analysing mechanisms of global change
  - Land and ocean surface
  - Atmosphere
- Links between remote sensing and other methods in global change research

*Image Processing and Computer Vision:* This lecture provides an overview of basic approaches of image processing and computer vision, starting from image filters like linear and non-linear filters, gradient and curvature operators and leading to concepts of object extraction based on point, line and segment extraction and their applications. The teaching concept consists of lectures and labs.

**Workload**

Einführung in Klassifizierungsverfahren der Fernerkundung (Pflicht): 120 h gesamt, davon 32 h Präsenz

Satellite climatology – remote sensing of a changing climate: 120 h total, thereof 32 contact hours

Image Processing and Computer Vision: 120 h total, thereof 32 h contact hours

## M

**6.7 Module: Experimental Meteorology (Met-ExpM2-1) [M-PHYS-100953]**

**Responsible:** Dr. Björn-Martin Sinnhuber  
**Organisation:** KIT Department of Physics  
**Part of:** [Applied and Experimental Meteorology](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
14	Grade to a tenth	Each summer term	1 term	English	4	5

Mandatory			
T-PHYS-109135	<a href="#">Advanced Practical Courses</a>	0 CR	Höpfner
T-PHYS-109136	<a href="#">Field Trip</a>	0 CR	Hoose
T-PHYS-109137	<a href="#">Experimental Meteorology (Module Exam)</a>	14 CR	Sinnhuber
T-PHYS-109902	<a href="#">Integrated Atmospheric Measurements</a>	0 CR	Schmitt
T-PHYS-111274	<a href="#">Remote Sensing of Atmosphere and Ocean</a>	0 CR	Sinnhuber

**Competence Certificate**

**Prerequisite:** Coursework ("Studienleistung")

For type of Coursework see Course description ("Teilleistungsbeschreibung")

→ successful completion of the prerequisites entitles to exam

**Examination:** Assessment ("Prüfungsleistung")

**T-PHYS-109137 Experimental Meteorology (Module Exam)**

Oral exam (approx. 60 minutes) in accordance with § 4 (2) No. 2 SPO Master's Meteorology

**Competence Goal**

The students can explain the functionality of modern meteorological measuring methods and measuring principles and name their possible uses. This is especially true for remote sensing, advanced in-situ, trace gas and aerosol measurements. The students are able to build and execute experiments in the lab or in the field according to instructions, to record and evaluate data scientifically founded and then interpret and present the results. They are aware of the Rules for Safeguarding Good Scientific Practice and the responsibilities associated with the production and use of scientific data, e.g. not to invent/pretend results or to distort or suppress undesired data and results.

**Module grade calculation**

Grade of the oral exam

**Content**

This module is intended to provide students with an overview of modern measurement methods in meteorology and practical aspects of application. In particular, this includes:

- **remote sensing** (physical basics, radiation transfer, inverse methods, basics of satellite remote sensing, techniques and applications),
- radar techniques (scattering and absorption of electromagnetic waves, radar equation, radar reflectivity factor and rain rate, technical aspects, radar beams in a stratified medium, wind information from Doppler radar data) and laser processes (properties and propagation of light, basics of the laser, functional principles of laser remote sensing, technical structure of lidar systems, overview of common lidar measuring methods, space-based lidar systems) as **integrated atmospheric measurements**.
- In addition, the module provides the students with an insight into and **practical experience** with modern measuring methods, such as those used in research at KIT and other institutions, on the basis of the internship and the excursion.

**Workload**

Presence time in lectures, exercises: 57 hours

Attendance time in excursion and practicals 100 hours

Preparation / follow-up: 143 hours

Exam preparation: 120 hours

## M

**6.8 Module: Fluid Mechanics and Turbulence (bauEX217-FMTURB) [M-BGU-105504]**

**Responsible:** Prof. Dr. Olivier Eiff  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [Required Electives](#) (Usage from 10/1/2020)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
9	Grade to a tenth	Each summer term	2 terms	English	4	1

Election block: Electives 1 (1 item as well as 6 credits)			
T-BGU-106612	<a href="#">Advanced Fluid Mechanics</a>	6 CR	Eiff
T-BGU-110841	<a href="#">Fluid Mechanics of Turbulent Flows</a>	6 CR	Uhlmann
Election block: Electives 2 (1 item as well as 3 credits)			
T-BGU-110411	<a href="#">Flow Measurement Techniques</a>	3 CR	Gromke
T-BGU-111060	<a href="#">Building and Environmental Aerodynamics</a>	3 CR	Gromke

**Competence Certificate**

One examination has to be taken in one of the 'Teilleistungen' 'Fluid Mechanics of Turbulent Flows' or 'Advanced Fluid Mechanics' and one other examination in one of the 'Teilleistungen' 'Flow Measurement Technique' or 'Building- and Environmental Aerodynamics'. The learning controls depend on the selected 'Teilleistungen' (s. 'Teilleistungen').

- 'Teilleistung' T-BGU-106612 with written examination according to § 4 Par. 2 No. 1
- 'Teilleistung' T-BGU-110841 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-110411 with oral examination according to § 4 Par. 2 No. 2
- 'Teilleistung' T-BGU-111060 with oral examination according to § 4 Par. 2 No. 1

details about the learning controls see at the respective 'Teilleistung'

**Competence Goal**

The Studierenden are able to explain basic terms and concepts in the field of fluid mechanics with appropriate terminology and attribute them to physical laws. They are familiar with examples of application, modelling and measurement.

**Module grade calculation**

grade of the module is the weighted average of the partial examinations from compulsory elective block 1 (75%), Advanced Fluid Mechanics or Fluid Mechanics of Turbulent Flows, and compulsory elective block 2 (25%), Flow Measurement Techniques or Building and Environmental Aerodynamics.

**Prerequisites**

none

**Content**

1. Advanced Fluid Mechanics teaches the advanced fundamentals of fluid mechanics and forms the basis for environmental fluid mechanics. Starting from the underlying local conservation laws, the phenomena of the different classes of flow and their possible analytical solutions are treated. This includes the general and special forms of the basic equations, flow kinematics, incompressible viscous flows, ideal fluid flows, shallow water flows and buoyancy effects in flows. Furthermore, waves and turbulence are addressed and different analysis methods such as scaling are treated.
2. Fluid Mechanics of Turbulent Flows provides the mathematical description of the physics of turbulence is successively developed. The module presents the phenomenology of turbulent flows, introduces the statistical description of turbulent flow processes, discusses the characteristics of free and wall-bounded shear flows, and presents an analysis of the turbulent energy cascade.
3. Flow Measurement Techniques teaches the basics of flow velocity measurement, with a focus on laser-optical measurement techniques such as those used in wind tunnels.
4. Building- and Environmental Aerodynamics gives an introduction to the natural wind and its interaction with the built and natural environment. In the focus are wind load on buildings and wind induced vibrations as well as flow processes in the natural environment regarding natural wind shelter, fresh air ventilation to urban areas and wind comfort.

**Recommendation**

basics in Mathematics and Hydromechanics;

prior knowledge in programming with Matlab is helpful for the course "Fluid Mechanics of Turbulent Flows"

start of the module in summer term

**Annotation**

none

**Workload**

contact hours (1 HpW = 1 h x 15 weeks):

depending on the selected courses or examinations, respectively:

- Advanced Fluid Mechanics lecture/exercise: 60 h
- Fluid Mechanics of Turbulent Flows lecture/exercise: 60 h
- Flow Measurement Techniques lecture/exercise: 30 h
- Building and Environmental Aerodynamics lecture/exercise: 30 hrs.

independent study:

depending on the selected courses or examinations, respectively:

- preparation and follow-up lecture/exercises Advanced Fluid Mechanics: 30 h
- working on exercises Advanced Fluid Mechanics: 30 h
- examination preparation Advanced Fluid Mechanics: 60 h
- preparation and follow-up lecture/exercises Fluid Mechanics of Turbulent Flows : 60 h
- examination preparation Advanced Fluid Mechanics: 60 h
- preparation and follow-up lecture/exercises Flow Measurement Techniques: 30 h
- examination preparation Flow Measurement Techniques: 30 h
- preparation and follow-up lecture/exercises Building and Environmental Aerodynamics: 30 h
- examination preparation Building and Environmental Aerodynamics: 30 h

total: 270 h

## M

**6.9 Module: Geoecology [M-BGU-103398]**

**Responsible:** Prof. Dr. Wolfgang Wilcke  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [Required Electives](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	2 terms	German	3	2

Mandatory			
T-BGU-107487	<a href="#">Geomorphology and Soil Science</a>	7 CR	Wilcke
T-BGU-107486	<a href="#">Field Course Soil Science</a>	1 CR	Wilcke

**Competence Certificate**

- Brick T-BGU-107487 with a written examination with 90 minutes according to § 4 Par. 2 No. 1 of the study and examination regulations (SPO) master meteorology

- Brick T-BGU-107486 with with not graded accomplishment (soil profile in small groups with approximately 2 pages) according to § 4 Par. 3 of the study and examination regulations (SPO) master meteorology

Details about the learning control see at the bricks

**Competence Goal**

The students know the basic terms, concepts and theories of the disciplines Geomorphology and Soil Science. They are able to recognize important land surface forms and to interpret them in a knowledgeable way. They know the composition, structure, properties and functions of soils.

**Module grade calculation**

Grade of the module is grade of the written examination

**Prerequisites**

None

**Content**

The module teaches the fundamental principles of Soil Science and Geomorphology. It consists of three courses with the following contents:

- Geomorphology and Soil Science: This brick treats the most important exogenic processes (weathering including karst, gravitational mass self-displacements, glacial and periglacial dynamics, eolic, fluvial and litoral dynamics, peneplains and escarpments). The soil is introduced as three-phases system and the individual phases (solid, liquid and gaseous) are discussed. Subject of this brick are the soil-forming factors and processes and the resulting suite of horizons of soils. Important physical properties of soils are introduced (color, texture, structure, mechanical stability, water retention and transport, heat budget). Important physico-chemical soil properties are treated (humus properties, soil acidity, redox potential, cation exchange). Ecological soil functions are presented. This brick moreover introduces the minerals of soils. The most important mineral formation processes are presented with a focus on silicates, oxides and sulfides. The interactions between microorganisms and soil minerals are discussed.
- Soils of Europe: This brick introduces the German soil classification and uses it as structure. The World Reference Base of Soil Resources and the US Keys to Soil Taxonomy are presented. The most important diagnostic properties of soils (surface and subsoil Horizons, specific properties) are taught. This brick puts all soil types of the German Soil Classification in their pedogenetic context. The brick treats the property-forming processes and the ecological soil properties resulting from these processes.
- Soil scientific field exercise: This brick consists of a one-day exercise in the surroundings of Karlsruhe, during which important local landscape features and soils are introduced and during which the students train the Interpretation of geomorphologic forms and properties of soil horizons.

**Recommendation**

The first attendance of the course "geomorphology and soil science" is recommended. The participation of the exercise "geomorphology and soil science" is optionally.

**Annotation**

None



**Workload**

1. Contact hours in lecture and exercises: 67,5 h
2. Preparation and follow-up: 142,5 h
3. Examination and exam preparation: 30 h

## M

**6.10 Module: Geological Hazards and Risk [M-PHYS-101833]**

**Responsible:** Dr. Ellen Gottschämmer  
**Organisation:** KIT Department of Physics  
**Part of:** [Required Electives](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	English	4	5

Mandatory			
T-PHYS-103525	<a href="#">Geological Hazards and Risk</a>	8 CR	Gottschämmer

**Competence Certificate**

Active and regular attendance of lecture and practicals. Project work (graded).

**Competence Goal**

The students understand basic concepts of hazard and risk. They can explain in detail different aspects of earthquake hazard, volcanic hazard as well as other geological hazards, can compare and evaluate those hazards. They have fundamental knowledge of risk reduction and risk management. They know methods of risk modelling and are able to apply them.

**Module grade calculation**

Project work will be graded.

**Prerequisites**

none

**Content**

- Earthquake Hazards
  - Short introduction to seismology and seismometry (occurrence of tectonic earthquakes, types of seismic waves, magnitude, intensity, source physics)
  - Induced seismicity
  - Engineering seismology, Recurrence intervals, Gutenberg-Richter, PGA, PGV, spectral acceleration, hazard maps
  - Earthquake statistics
  - Liquefaction
- Tsunami Hazards
- Landslide Hazards
- Hazards from Sinkholes
- Volcanic Hazards
  - Short introduction to physical volcanology
  - Types of volcanic hazards
- The Concept of Risk, Damage and Loss
- Data Analysis and the use of GIS in Risk analysis
- Risk Modelling - Scenario Analysis
- Risk Reduction and Risk Management
- Analysis Feedback and Prospects in the Risk Modelling Industry

**Workload**

- 60 h: active attendance during lectures and exercises
- 90 h: review, preparation and weekly assignments
- 90 h: project work

**Learning type**

4060121 Geological Hazards and Risk (V2)

4060122 Übungen zu Geological Hazards and Risk (Ü2)

**Literature**

Literature will be provided by the lecturer.

## M

**6.11 Module: Geophysical analysis of natural hazards [M-PHYS-103336]**

**Responsible:** Dr. Ellen Gottschämmer  
**Organisation:** KIT Department of Physics  
**Part of:** Required Electives

<b>Credits</b> 8	<b>Grading scale</b> Grade to a tenth	<b>Recurrence</b> Each summer term	<b>Duration</b> 2 terms	<b>Language</b> English	<b>Level</b> 4	<b>Version</b> 3
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<b>Mandatory</b>			
T-PHYS-103553	<a href="#">Introduction to Volcanology, Prerequisite</a>	3 CR	Gottschämmer
T-PHYS-103644	<a href="#">Introduction to Volcanology, Exam</a>	1 CR	Gottschämmer
T-PHYS-107673	<a href="#">Seminar on Recent Topics of Risk Science</a>	4 CR	Gottschämmer

**Competence Certificate****Introduction to Volcanology**

Active and regular attendance of lecture and practicals, presentation of a volcano in a short (10 – 15 minute) talk with slides, submission of a scientific essay about their presentation, approx. 8-10 pages, which will be graded.

**Seminar on recent topics of risk science**

Preparation and presentation of a talk based on a scientific publication, critical discussion of the scientific results.

**Competence Goal****Introduction to Volcanology**

The Students know and understand the basic concepts of physical volcanology. They are able to classify volcanoes by their tectonic location, can discriminate between different eruption types and describe different volcanic edifices with respect to their tectonic environment. They understand the concept of volcanic hazard and risk and are able to apply it. They can explain the physics of volcanic monitoring methods and know about their advantages and disadvantages. They gained insight into numerical modelling tools and can name several applications. The students understand the impact of volcanic eruptions on climate and know both, presently as well as historically active volcanoes and their prominent eruptions.

The students have gained an overview about active volcanoes and recent eruptions and are able to summarize the main characteristics and scientific achievements about one volcano of their choice in a 10-15 minute talk. They are able to discuss and answer questions related to their subject. They can summarize their research about the volcano of their choice in a scientific essay (8-10 pages).

**Seminar on recent topics of risk science**

The students understand scientific literature regarding current topics of natural hazards and risk. They can summarize a selected topic, describe and explain the main idea to their fellow students in an oral presentation (30-40 minutes). They know how to structure and present a scientific talk. They are able to understand the topics presented by their fellow students, discuss and analyze the content critically. They are able to compare those research results and evaluate the content critically.

**Module grade calculation**

The grade of the module results from grade of of the scientific essay of "Introduction to Volcanology".

**Content****Introduction to Vulcanology**

- Introduction, Overview
- Volcanoes and Plate Tectonics
- Magma and Volcanic Deposits
- Eruption types
- Volcanic Edifices
- Volcanic Hazard and Risk
- Volcano Monitoring
- Volcano Seismology
- Numerical Modelling of Volcanic Products
- Historic Eruptions
- Volcanoes and Climate

**Seminar on recent topics of risk science**

The students will read and discuss current literature about current topics of natural hazards and risk.

**Learning type**

4060251 Introduction to Volcanology (V1)

4060252 Exercises to Introduction to Volcanology (Ü1)

4060254 Seminar über aktuelle Fragen aus der Risikoforschung (S2)

**Literature**

Literature will be provided by the lecturer.

## M

## 6.12 Module: GIS and Geo Data Infrastructures [M-BGU-102760]

**Responsible:** Prof. Dr.-Ing. Stefan Hinz

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** Required Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
10	Grade to a tenth	Each winter term	2 terms	German	4	2

Mandatory			
T-BGU-101681	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	3 CR	Rösch, Wursthorn
T-BGU-103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite	3 CR	Rösch, Wursthorn
T-BGU-101756	Geo Data Infrastructures and Web Services	1 CR	Wursthorn
T-BGU-101757	Geodata Infrastructures and Web-Services, Prerequisite	3 CR	Wursthorn

### Competence Certificate

Einführung in GIS: schriftliche Klausur (90 min.); Geodateninfrastrukturen: mündliche Prüfung (20 min.) oder schriftliche Ausarbeitung

### Competence Goal

Die Studierenden sind mit der Erfassung, Analyse und Präsentation von Daten mit Raumbezug vertraut. Darüber hinaus kennen sie die unterschiedlichen Aspekte geometrischer und topologischer Modellierung und beherrschen die Sachdatenverwaltung.

Die Studierenden verstehen ferner die grundlegenden Prinzipien eines Geoinformationssystems und sind mit der Definition des Raumbezugs vertraut. Sie sind in der Lage, einfache projektbezogene Fragestellungen selbstständig zu bearbeiten.

Darüber hinaus können sie standardisierte Geo-Webdienste erklären und diese Dienste auf der Client-Seite nutzen und diese selbst als Service zur Verfügung stellen. Die Studierenden können dabei ihr Wissen über Geodateninfrastrukturen an konkreten, praktischen Fragestellungen anwenden.

### Module grade calculation

weighted mean

### Prerequisites

None

### Content

*Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen:* Bezugs- und Koordinatensysteme sowie deren Transformation (z.B. UTM, Gauß-Krüger); Grundlagen der Informatik (z.B. Datenbanken, SQL); Geodatenmodellierung und Erfassung (z.B. GNSS); Normierung und Standardisierung in GIS (z.B. ISO, OGC, WFS, WMS); Einfache Algorithmen (z. B. „Point in Polygon“); Software: Vornehmlich QGIS, ArcGIS, Web-GIS u. a.

*Geodateninfrastrukturen und Webdienste:* Das Modul befasst sich mit den standardisierten Geodateninfrastrukturen INSPIRE, GDI-DE und behandelt die dafür nötigen OGC Dienste. Darüber hinaus wird Überblick über Geo-Webdienste außerhalb der OGC-Welt gegeben.

### Workload

Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen: 180 h gesamt, davon Präsenzzeit 45 h

Geodateninfrastrukturen und Web-Dienste: 120 h gesamt, davon Präsenzzeit 45 h

## M

**6.13 Module: GIS and Remote Sensing [M-BGU-102758]****Responsible:** Prof. Dr.-Ing. Stefan Hinz**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences**Part of:** Required Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
9	Grade to a tenth	Each winter term	2 terms	German	4	2

Mandatory			
T-BGU-105725	Introduction into Classification Methods of Remote Sensing	4 CR	Weidner
T-BGU-101681	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	3 CR	Rösch, Wursthorn
T-BGU-103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite	3 CR	Rösch, Wursthorn

**Competence Certificate**

Online test, written exam (90 min.), oral exam (approx. 20 min.)

**Competence Goal**

Die Studierenden sind mit der Erfassung, Analyse und Präsentation von Daten mit Raumbezug vertraut. Darüber hinaus kennen sie die unterschiedlichen Aspekte geometrischer und topologischer Modellierung und beherrschen die Sachdatenverwaltung.

Die Studierenden verstehen ferner die grundlegenden Prinzipien eines Geoinformationssystems und sind mit der Definition des Raumbezugs vertraut. Sie sind in der Lage, einfache projektbezogene Fragestellungen selbständig zu bearbeiten.

Darüber hinaus können sie die Grundlagen der Fernerkundung erklären sowie grundlegende Klassifizierungsverfahren benennen, erläutern und selbsttätig anwenden.

**Module grade calculation**

weighted mean

**Prerequisites**

None

**Content**

*Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen:* Bezugs- und Koordinatensysteme sowie deren Transformation (z.B. UTM, Gauß-Krüger); Grundlagen der Informatik (z.B. Datenbanken, SQL); Geodatenmodellierung und Erfassung (z.B. GNSS); Normierung und Standardisierung in GIS (z.B. ISO, OGC, WFS, WMS); Einfache Algorithmen (z. B. „Point in Polygon“); Software: Vornehmlich QGIS, ArcGIS, Web-GIS u. a.

*Einführung in Klassifizierungsverfahren der Fernerkundung:* Die in den Vorlesungen und Übungen behandelten Themen umfassen die Themenbereiche Vorprozessierung und Visualisierung von Fernerkundungsdaten und deren Eigenschaften, grundlegende Klassifizierungsverfahren und Prinzipien der Bewertung der Klassifizierungsgüte sowie Anwendungsbereiche von Klassifizierungen und deren Ergebnisse hinsichtlich Landbedeckung und Landnutzung.

**Recommendation**

None

**Annotation**

None

**Workload**

Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen: 180 h gesamt, davon Präsenzzeit 45 h

Einführung in Klassifizierungsverfahren der Fernerkundung: 90 h gesamt, davon Präsenzzeit 32 h



## M

**6.14 Module: Informatics for Meteorology Students [M-INFO-102980]**

**Responsible:** Prof. Dr. Bernhard Beckert  
**Organisation:** KIT Department of Informatics  
**Part of:** [Required Electives](#)

**Credits**  
8

**Grading scale**  
Grade to a tenth

**Duration**  
2 terms

**Language**  
German

**Level**  
4

**Version**  
3

<b>Election block: Informatics for Meteorology Students (at least 1 item as well as at least 8 credits)</b>			
T-INFO-101345	<a href="#">Parallel Computer Systems and Parallel Programming</a>	4 CR	Streit
T-INFO-101298	<a href="#">Distributed Computing</a>	4 CR	Streit
T-INFO-102061	<a href="#">Mobile Computing and Internet of Things</a>	5 CR	Beigl
T-INFO-101497	<a href="#">Database Systems</a>	4 CR	Böhm
T-INFO-101275	<a href="#">Visualization</a>	5 CR	Dachsbacher
T-INFO-111622	<a href="#">Data Science I</a>	5 CR	Böhm, Fouché

**Competence Certificate**

Die Erfolgskontrollen werden in den jeweiligen Teilleistungen beschrieben.

**Competence Goal****T-INFO-101345 Parallelrechner und Parallelprogrammierung**

Qualifikationsziele: Studierende erörtern die Grundbegriffe paralleler Architekturen und die Konzepte ihrer Programmierung. Sie analysieren verschiedene Architekturen von Höchstleistungsrechnern und differenzieren zwischen verschiedene Typen anhand von Beispielen aus der Vergangenheit und Gegenwart. Studierende analysieren Methoden und Techniken zum Entwurf, Bewertung und Optimierung paralleler Programme, die für den Einsatz in Alltags- oder industriellen Anwendungen geeignet sind und wenden diese an. Studierende können Probleme im Bereich der Parallelprogrammierung beschreiben, analysieren, und beurteilen.

**T-INFO-101298 Verteiltes Rechnen**

Qualifikationsziele: Studierende verstehen die Grundbegriffe verteilter Systeme, im Speziellen in den aktuellen Techniken des Grid und Cloud Computing sowie des Management großer bzw. verteilter Daten. Sie wenden zugrundeliegenden Paradigmen und Services auf gegebene Beispiel an. Studierende analysieren Methoden und Technologien des Grid und Cloud Computing sowie verteilten Daten-Managements, die für den Einsatz in alltags- und industriellen Anwendungsgebieten geeignet sind bzw. welche heute von Google, Facebook, Amazon, etc. eingesetzt werden. Hierfür vergleichen die Studierenden Web/Grid Services, elementare Grid Funktionalitäten, Datenlebenszyklen, Metadaten, Archivierung, Cloud Service Typen (IaaS, SaaS, PaaS) und Public/Private Clouds anhand von Beispielen aus der Praxis.

**T-INFO-102061 Mobile Computing und Internet der Dinge** Qualifikationsziele: Mobile Computing und Internet der Dinge ermöglichen es im beruflichen und privaten Alltag ubiquitär auf Informationen und Dienste zuzugreifen. Diese Dienste reichen von Augmented-Reality Informationsdiensten über den Ad-Hoc Austausch von Daten zwischen benachbarten Smartphones bis hin zur Haussteuerung. Ziel der Vorlesung ist es, Kenntnisse über Grundlagen, weitergehende Methoden und Techniken des Mobile Computing und des Internet der Dinge zu erwerben. Nach Abschluss der Vorlesung können die Studierenden:

- Techniken zur Gestaltung von Mobile Computing Software und Benutzerschnittstellen für Mobile Computing Anwendungen benennen, beschreiben und erklären und bewerten
- Software- und Kommunikationsschnittstellen für das Internet der Dinge und Basiskennnisse zu Personal Area Networks (PAN) benennen, beschreiben, vergleichen und bewerten
- selbständig Systeme für Mobile Computing und das Internet der Dinge entwerfen, Entwürfe analysieren und bewerten
- eine adaptive Webseite entwerfen, implementieren und auf ihre Usability hin untersuchen
- eine eigene App konzipieren und implementieren, die über Bluetooth mit einem Gerät kommuniziert

**T-INFO-101305 Analysetechniken für große Datenbestände**

Qualifikationsziele: Am Ende der Lehrveranstaltung sollen die Teilnehmer die Notwendigkeit von Konzepten der Datenanalyse gut verstanden haben und erläutern können. Sie sollen unterschiedliche Ansätze zur Verwaltung und Analyse großer Datenbestände hinsichtlich ihrer Wirksamkeit und Anwendbarkeit einschätzen und vergleichen können. Die Teilnehmer sollen verstehen, welche Probleme im Themenbereich der Vorlesung derzeit offen sind, und einen Einblick in den diesbezüglichen Stand der Forschung gewonnen haben.

**T-INFO-101497 Datenbanksysteme**

Qualifikationsziele:

Der/die Studierende:

- ist in der Lage den Nutzen von Datenbank-Technologie darzustellen,
- kennt die Modelle und Methoden bei der Entwicklung von funktionalen Datenbank-Anwendungen,
- ist in der Lage selbstständig einfache Datenbanken anzulegen und Zugriffe auf diese zu tätigen, kennt und versteht die entsprechenden Begrifflichkeiten und die Grundlagen der zugrundeliegenden Theorie

**T-INFO-101275 Visualisierung**

Qualifikationsziele:

Die Studierenden lernen in dieser Vorlesung wichtige Algorithmen und Verfahren der Visualisierung kennen und können diese unterschiedlichen Anwendungsfeldern zuordnen, sie analysieren und bewerten. Die erworbenen Kenntnisse sind in vielen Bereichen der Forschung in der Computergrafik, und der (Medizin-/Bio-/Ingenieurs-)Informatik wertvoll. Die Studierenden können für ein gestelltes Problem geeignete Visualisierungstechniken auswählen und selbst implementieren.

**Content****T-INFO-101345 Parallelrechner und Parallelprogrammierung**

Inhalt:Die Vorlesung gibt eine Einführung in die Welt moderner Parallel- und Höchstleistungsrechner, des Supercomputings bzw. des High-Performance Computings (HPC) und die Programmierung dieser Systeme.Zunächst werden allgemein und exemplarisch Parallelrechnersysteme vorgestellt und klassifiziert. Im Einzelnen wird auf speichergekoppelte und nachrichtengekoppelte System, Hybride System und Cluster sowie Vektorrechner eingegangen. Aktuelle Beispiele der leistungsfähigsten Supercomputer der Welt werden ebenso wie die Supercomputer am KIT kurz vorgestellt.Im zweiten Teil wird auf die Programmierung solcher Parallelrechner, die notwendigen Programmierparadigmen und Synchronisationsmechanismen, die Grundlagen paralleler Software sowie den Entwurf paralleler Programme eingegangen. Eine Einführung in die heute üblichen Methoden der parallelen Programmierung mit OpenMP und MPI runden die Veranstaltung ab.

**T-INFO-101298 Verteiltes Rechnen**

Inhalt:Die Vorlesung „Verteiltes Rechnen“ gibt eine Einführung in die Welt des verteilten Rechnens mit einem Fokus auf Grundlagen, Technologien und Beispielen aus Grid, Cloud und dem Umgang mit Big Data.Zuerst wird eine Einführung in die Hauptcharakteristika verteilter Systeme gegeben. Danach wird auf die Thematik Grid näher eingegangen und es werden Architektur, Grid Services, Sicherheit und Job Ausführung vorgestellt. Am Beispiel des WLCG (der Grid Infrastruktur zur Verteilung, Speicherung und Analyse der Daten des LHC-Beschleunigers am CERN) wird die enge Verwandtschaft zwischen Grid Computing und verteiltem Daten-Management dargestellt.Im zweiten Teil werden Prinzipien und Werkzeuge zum Management großer bzw. verteilter Daten vorgestellt - dies schließt Datenlebenszyklus, Metadaten und Archivierung ein. Beispiele aus Wissenschaft und Industrie dienen zur Veranschaulichung. Moderne Speichersysteme wie z.B. dCache, xrootd, Ceph und HadoopFS werden als praktische Beispiele vorgestellt.Der dritte Teil der Vorlesung geht auf das Thema Cloud ein. Nach der Definition grundlegender Begriffe und Prinzipien (IaaS, PaaS, SaaS, public vs. private Clouds), auch mittels Beispielen, wird das Thema Virtualisierung als grundlegende Technik des Cloud Computing vorgestellt. Den Abschluss bildet MapReduce als Mechanismus zur Verarbeitung und Analyse großer, verteilter Datenbestände wie es auch von Google eingesetzt wird.

**T-INFO-102061 Mobile Computing und Internet der Dinge**

Inhalt:Die Vorlesung bietet eine Einführung in Methoden und Techniken des mobile Computing und des Internet der Dinge (Internet of Things, IoT). Die Übung vertieft das in der Vorlesung erworbene Wissen in einem Praxisprojekt. Im praktischen Teil wird insbesondere die Erstellung von Benutzerschnittstellen für Anwendungen im Bereich Mobile Computing und dem Internet der Dinge sowie von Software-Apps erlernt. Die praktische Übung startet mit den Aspekten Benutzerschnittstellendesign und Software-Entwurf. Es begleitet dann mit kleinen Programmieraufgaben die technischen Teile der gesamte Vorlesung.Die Vorlesung gliedert sich in folgende Themenbereiche:Mobile Computing:• Plattformen: Smartphones, Tablets, Glasses• Mensch-Maschine-Interaktion für Mobile Computing• Software Engineering, -Projekte und Programmierung für mobile Plattformen (native Apps, HTML5)• Sensoren und deren Einsatz• Plattformen und Software Engineering für das Internet der Dinge: Raspberry Pi und Arduino• Personal Area Networks: Bluetooth (4.0), ANT• Home Networks: ZigBee/IEEE 802.15.4, CEBus, m-bus• Technologien des Internet der Dinge, IoT: RFID, NFC, Auto-ID, EPC, Web of Things

**T-INFO-101305 Analysetechniken für große Datenbestände**

Inhalt:Techniken zur Analyse großer Datenbestände stoßen bei Anwendern auf großes Interesse. Das Spektrum ist breit und umfasst klassische Branchen wie Banken und Versicherungen, neuere Akteure, insbesondere Internet-Firmen oder Betreiber neuartiger Informationsdienste und sozialer Medien, und Natur- und Ingenieurwissenschaften. In allen Fällen besteht der Wunsch, in sehr großen, z. T. verteilten Datenbeständen die Übersicht zu behalten, mit möglichst geringem Aufwand interessante Zusammenhänge aus dem Datenbestand zu extrahieren und erwartetes Systemverhalten mit dem tatsächlichen systematisch vergleichen zu können. In der Vorlesung geht es sowohl um die Aufbereitung von Daten als Voraussetzung für eine schnelle und leistungsfähige Analyse als auch um moderne Techniken für die Analyse an sich.

**T-INFO-101497 Datenbanksysteme**

Inhalt:Datenbanksysteme gehören zu den entscheidenden Softwarebausteinen in modernen Informationssystemen und sind ein zentrales Thema der Universitätsstudiengänge im Gebiet der Informatik. Ziel der Vorlesung ist die Vermittlung von Grundkenntnissen zur Arbeit mit Datenbanken. Die wichtigen Themen der Vorlesung sind guter Datenbankentwurf, der Zugriff auf Datenbanken und die Anbindung an Anwendungen, Mehrbenutzerbetrieb und eine Übersicht über unterschiedliche Datenbanktypen (relational vs. NoSQL insbesondere).

**T-INFO-101275 Visualisierung**

Inhalt:Die Visualisierung beschäftigt sich mit der visuellen Repräsentation von Daten aus wissenschaftlichen Experimenten, Simulationen, medizinischen Scannern, Datenbanken etc., mit dem Ziel ein größeres Verständnis oder eine einfachere Repräsentation komplexer Vorgänge zu erhalten. Hierzu werden u.a. Methoden aus der interaktiven Computergrafik herangezogen und neue Methoden entwickelt. Diese Vorlesung behandelt die sogenannte Visualisierungspipeline, spezielle Algorithmen und Datenstrukturen und zeigt praktische Anwendungen.Themen dieser Vorlesung sind u.a.:• Einführung, Visualisierungspipeline• Datenakquisition und -repräsentation• Perception und Abbildung (Mapping) auf grafische Repräsentationen• Visualisierung von Skalarfeldern (Isoflächenextraktion, Volumenrendering)• Visualisierung von Vektorfeldern (Particle Tracing, texturbasierte Methoden)• Tensorfelder und Daten mit mehreren Attributen• Informationsvisualisierung

**Annotation**

Qualifikationszeile und Inhalt sind der jeweiligen Module der gewählten Teilleistungen zu entnehmen.

**Workload**

mind. 240 Stunden.

## M

**6.15 Module: Interdisciplinary Qualifications [M-PHYS-102352]**

**Responsible:** Prof. Dr. Corinna Hoose  
**Organisation:** KIT Department of Physics  
**Part of:** [Interdisciplinary Qualifications](#)

**Credits**  
4

**Grading scale**  
Grade to a tenth

**Language**  
German

**Level**  
1

**Version**  
1

Election block: Elective Studies (at least 4 credits)			
T-PHYS-104675	<a href="#">Wildcard</a>	2 CR	
T-PHYS-104677	<a href="#">Wildcard</a>	2 CR	

## M

**6.16 Module: Master Thesis (Met-MMAr4-1) [M-PHYS-100956]**

**Responsible:** Prof. Dr. Corinna Hoose  
**Organisation:** KIT Department of Physics  
**Part of:** [Master Thesis](#)

<b>Credits</b> 30	<b>Grading scale</b> Grade to a tenth	<b>Recurrence</b> Each term	<b>Duration</b> 1 term	<b>Language</b> German/English	<b>Level</b> 4	<b>Version</b> 3
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<b>Mandatory</b>			
T-PHYS-109616	<a href="#">Master's Thesis</a>	30 CR	Hoose

**Competence Certificate****Module examination: Assessment ("Prüfungsleistung")**

Written report (Master's thesis) and presentation (SPO §14 (1a)) in accordance with § 14 SPO Master's Meteorology evaluated by at least one professor, one habilitated scientist of the KIT-Faculty of Physics or one leading scientist in accordance with § 14 Abs. 3 para. 1 KITG and one other examiner. The overall assessment will be recorded in a written report.

The evaluation period shall not exceed eight weeks upon submission of the Master's thesis.

**Competence Goal**

Students can independently develop and carry out a scientific work. To this end, they deal with the latest state of research and apply the knowledge and the methods acquired during studies. They can discuss and evaluate the obtained results and present them in writing as well as defend the work in a presentation.

The students are able to work on a coherent problem from their field of study independently and in a limited time according to scientific methods and then present the knowledge gained in a written paper and in a presentation in an understandable and precise manner and to discuss it competently.

Furthermore, the students are aware of their responsibility in dealing with self-obtained data, developed methods and used materials and their storage. They are able to correctly handle primary data of other researchers and to protect their copyrights.

**Module grade calculation**

The overall grade results from the evaluation of the thesis. This includes the final presentation.

**Prerequisites**

Students have successfully completed modules with a minimum of 70 ECTS credits, especially the module *Specialization Phase* must be successfully completed. (SPO §14)

**Modeled Conditions**

The following conditions have to be fulfilled:

- You need to earn at least 40 credits in the following fields:
  - Applied and Experimental Meteorology
  - Atmospheric and Climate Processes
  - Interdisciplinary Qualifications
  - Required Electives
- The module [M-PHYS-100955 - Specialisation Phase](#) must have been passed.

**Content**

After choosing a subject area and topic at the beginning of the module *Specialization Phase* and preparing their thesis, the students start their original scientific study. The Master's Thesis includes the theoretical and/or the experimental work on a complex problem using scientific methods.

It is possible to conduct the project in cooperation with external partners, for example an external research institution or an institution from the professional background.

**Recommendation**

Attendance of the Karlsruhe Meteorological Colloquium and the departmental seminars (IMK-TRO, IMK-ASF, IMK-AAF).

**Annotation**

The maximum duration of the Master thesis is six months.

**Workload**

Presence on Presentations: 20 hours  
 Preparation of the presentation: 40 hours  
 Master's Thesis: 840 hours

## M

## 6.17 Module: Modern Theoretical Physics for Teacher Students [M-PHYS-101664]

**Responsible:** Studiendekan Physik  
**Organisation:** KIT Department of Physics  
**Part of:** [Required Electives](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each winter term	1 term	German	4	1

Mandatory			
T-PHYS-103203	<a href="#">Modern Theoretical Physics for Teacher Students - Prerequisite</a>	0 CR	Eder
T-PHYS-103204	<a href="#">Modern Theoretical Physics for Teacher Students</a>	8 CR	Eder

**Competence Certificate**

See components of this module

**Competence Goal**

The students know the fundamentals of the theory of electric and magnetic fields and the electrical and magnetic properties of matter. Fundamentals of quantum mechanics with simple applications.

**Prerequisites**

none

**Content**

- Electrostatics: basic equations, scalar potential, examples.
- Magneto statics: basic equations, vector potential, examples.
- Special relativity theory, relativistic formulation of electrodynamics.
- Time-dependent fields and radiation phenomena: basic equations, Poynting theorem.
- Electromagnetic waves: plane waves, polarization, wave packets, spherical waves, electromagnetic potentials and gauge transformations, Hertzian dipole.
- Basic equations of quantum mechanics. Uncertainty principle. Interpretation of the wave function. A particle in one dimension. Multiparticle states, Pauli principle. Energy eigenstates of the hydrogen atom. Atomic structure and periodic table of the elements in the model of hydrogen-like atoms.

**Workload**

240 hours composed of active time (90), wrap-up of the lecture incl. preparation of the examination and the exercises (150)

**M****6.18 Module: Modern Theoretical Physics I, Quantum Mechanics I [M-PHYS-101707]**

**Responsible:** Studiendekan Physik  
**Organisation:** KIT Department of Physics  
**Part of:** [Required Electives](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-PHYS-102317	<a href="#">Modern Theoretical Physics I, Quantum Mechanics 1, Prerequisite 1</a>	4 CR	Schmalian
T-PHYS-105134	<a href="#">Modern Theoretical Physics I, Quantum Mechanics 1</a>	4 CR	Studiendekan Physik

**Competence Certificate**

See components of this module

**Competence Goal**

The student learns the basic concepts of single-particle quantum mechanics and applies them to important questions. He / she lays the foundation for a fundamental understanding of the microscopic world.

**Prerequisites**

none

**Content**

- Introduction: Historical Remarks, Limitations of Classical Physics
- Dualism particle and wave: wave mechanics, matter waves, wave packets, uncertainty principle, Schrödinger equation, qualitative understanding of simple cases.
- Mathematical tools: Hilbert space, Bra and Ket, operators, hermiticity, unitarity, eigenvectors and eigenvalues, observable, basis, completeness.
- Postulates of quantum mechanics: measurement process, time evolution, time evolution of expectation values, Ehrenfest theorem and classical borderline case.
- One-dimensional potentials: Potential wells, harmonic oscillator.
- Bound states in a three-dimensional potential: separation of variables, central potential, angular momentum, rotational symmetry and spin, degeneracy, particles in the external electromagnetic field, hydrogen atom.
- Time-independent perturbation theory: Neat and degenerate case, fine structure of the hydrogen spectrum, Stark effect.
- Basics of Scattering Theory: Differential cross section, Born series and Born approximation, partial waves and scattering phases, optical theorem.

**Workload**

240 hours composed of active time (90), wrap-up of the lecture incl. preparation of the examination and the exercises (150)

**Literature**

Textbooks on quantum mechanics

## M

## 6.19 Module: Module Wildcard Electives [M-PHYS-103403]

**Organisation:** University

**Part of:** Required Electives

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
8	Grade to a tenth	Each term	1 term	German	4	1

Election block: Wildcard (at least 1 item)			
T-PHYS-106794	<a href="#">Wildcard</a>		2 CR
T-PHYS-106795	<a href="#">Wildcard</a>		3 CR
T-PHYS-106796	<a href="#">Wildcard</a>		4 CR
T-PHYS-106797	<a href="#">Wildcard</a>		5 CR

**Prerequisites**

None



## M

**6.20 Module: Numerical Methods [M-MATH-100536]**

**Responsible:** Prof. Dr. Wolfgang Reichel  
**Organisation:** KIT Department of Mathematics  
**Part of:** [Required Electives](#) (Usage from 10/1/2020)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
5	Grade to a tenth	Each summer term	1 term	German	4	1

Mandatory			
T-MATH-100803	<a href="#">Numerical Methods - Exam</a>	5 CR	Kunstmann, Plum, Reichel

**Competence Certificate**

Die Erfolgskontrolle erfolgt im Rahmen einer schriftlichen Gesamtprüfung (120 Minuten) nach § 4 Abs. 2 Nr.1 SPO-MA2015-016.

**Competence Goal**

Absolventinnen und Absolventen sind am Ende des Moduls mit grundlegenden Konzepten und Denkweisen auf dem Gebiet der numerischen Mathematik vertraut. Sie kennen unterschiedliche Verfahren zur Lösung linearer und nichtlinearer Probleme der numerischen Mathematik und sind in der Lage, numerische Methoden auf Probleme in den Anwendungen selbständig, sicher, kritisch und bedarfsgerecht anzuwenden.

**Module grade calculation**

Die Modulnote ist die Note der schriftlichen Prüfung.

**Prerequisites**

none

**Content**

In der Vorlesung werden grundlegende Ideen und numerische Verfahren zu den nachfolgend aufgeführten Themenbereichen vorgestellt:

Lineare Gleichungssysteme, Gauß-Algorithmus, LR-Zerlegung, Cholesky-Zerlegung  
 Eigenwertprobleme, von-Mises Iteration  
 Lineare Optimierung  
 Fehleranalyse  
 Newton-Verfahren  
 Quadratur, Newton-Cotes Formeln  
 Numerische Lösung von Anfangswertproblemen, Runge-Kutta Verfahren  
 Finite Differenzen Verfahren zur Lösung von Randwertproblemen  
 Finite Elemente

**Workload**

Gesamter Arbeitsaufwand: 150 Stunden

Präsenzzeit: 45 Stunden

•Lehrveranstaltung einschließlich studienbegleitender Modulprüfung

Selbststudium: 105 Stunden

- Vertiefung der Studieninhalte durch häusliche Nachbearbeitung des Vorlesungsinhaltes
- Bearbeitung von Übungsaufgaben
- Vertiefung der Studieninhalte anhand geeigneter Literatur und Internetrecherche
- Vorbereitung auf die studienbegleitende Modulprüfung

## M

**6.21 Module: Physics of Planetary Atmospheres [M-PHYS-104488]**

**Responsible:** Prof. Dr. Thomas Leisner  
**Organisation:** KIT Department of Physics  
**Part of:** [Required Electives](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
10	Grade to a tenth	Each winter term	1 term	English	4	3

Mandatory			
T-PHYS-109177	<a href="#">Physics of Planetary Atmospheres</a>	8 CR	Leisner
T-PHYS-109180	<a href="#">Exam on Physics of Planetary Atmospheres</a>	2 CR	Leisner

**Competence Certificate**

**Prerequisite:** Coursework ("Studienleistung")

For type of Coursework see Course description ("Teilleistungsbeschreibung")

→ successful completion of the prerequisites entitles to exam

**Examination:** Assessment ("Prüfungsleistung")

T-PHYS-109180 Exam on Physics of Planetary Atmospheres

Exam (approx. 60 minutes, oral, written or otherwise) in accordance with § 4 (2) SPO Master's Meteorology

**Competence Goal**

The students acquire the basic knowledge of atmospheric physics.

On the basis of concrete case studies from current research, the students learn to understand the concepts and are empowered to apply the learned methods independently.

Emphasis is placed on the basic physical and chemical principles, so that knowledge can be generally applied to planetary atmospheres and not limited to the earth. This is supported by correspondingly created exercises.

One focus is the experimental methods of atmospheric remote sensing.

Methods Learning:

- Understanding the basics of atmospheric physics
- Acquisition of the ability to present a current research topic independently as well as in a team
- Acquisition of the ability to apply the concepts and experimental methods in an experimental To implement a master's thesis

**Module grade calculation**

Grade is earned through the associated exam (oral, written or otherwise).

**Prerequisites**

None

**Content**

The topics covered include a general introduction to the field of work with its fundamental questions, theoretical concepts and experimental methods.

One of the focal points is radiation transport in atmospheres, which is of central importance for the energy budget as well as for remote sensing. Clouds and aerosols are a central factor in many planetary atmospheres, their nucleation and their properties are treated in generalized form.

**Recommendation**

Basic knowledge of physics, physical chemistry and fluid dynamics at Bachelor level

**Workload**

240 hours consisting of attendance times (60 hours), follow-up of the lecture incl.

Exam preparation and editing exercises (180 hours).

**Learning type**

Lectures (2 Ch) and Exercises (2Ch)

**Literature**

Raymond T. Pierrehumbert: Principles of Planetary Climate, Cambridge Univ. Press, 2010

Augustin Sanchez-Lavega: An Introduction to Planetary Atmospheres, Taylor&Francis, 2010

Frédéric J. Pont: Alien Skies: Planetary Atmospheres from Earth to Exoplanets, Springer, 2014

K. N. Liu: An introduction to atmospheric radiation, Academic Press, 2010

**M****6.22 Module: Satellite Climatology: Remote Sensing of a Changing Climate [M-BGU-105095]****Responsible:** Prof. Dr. Jan Cermak**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences**Part of:** [Required Electives](#)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	Grade to a tenth	Each winter term	1 term	German/English	4	1

Mandatory			
T-BGU-110305	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Examination</a>	3 CR	Cermak
T-BGU-110304	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Prerequisite</a>	1 CR	Cermak

**Competence Certificate**

- T-BGU-110304 Satellite climatology: Remote Sensing of a Changing Climate, Prerequisite
- T-BGU-110305 Satellite climatology: Remote Sensing of a Changing Climate

For details on the individual performance reviews, see the respective "Teilleistungen".

**Competence Goal**

Students explain the contribution of remote sensing to the assessment of climate change and its consequences in time and space. They relate how remote sensing assessments help further the understanding of processes driving global change. Students independently choose and apply methods and data sets suited for the analysis of specific aspects of global change.

**Module grade calculation**

The grade of the module is the grade of the exam in T-BGU-110305 Satellite climatology: Remote Sensing of a Changing Climate

**Prerequisites**

M-BGU-103313 Remote Sensing of a Changing Climate must not have started

**Content**

- **Basics** of global change: Mechanisms and patterns
- Remote sensing approaches to analysing **patterns** of global change:
  - Land and ocean surface
  - Atmosphere
- Remote sensing approaches to analysing **mechanisms** of global change
  - Land and ocean surface
  - Atmosphere
- **Links** between remote sensing and other methods in global-change research

**Annotation**

Knowledge in geosciences/climate and statistics are helpful.

**Workload**

**Total workload: 120 hours**

**Contact hours: 30 hours**

- courses plus course-related examination

**Self-study: 90 hours**

- consolidation of subject by recapitulation of lectures
- consolidation of subject by use of references and by own inquiry – preparation of the monitoring project
- data analysis and data processing
- preparations for exam

## M

## 6.23 Module: Specialisation Phase (Met-Spph3-1) [M-PHYS-100955]

**Responsible:** Prof. Dr. Corinna Hoose  
**Organisation:** KIT Department of Physics  
**Part of:** [Research Work](#)

<b>Credits</b> 30	<b>Grading scale</b> pass/fail	<b>Recurrence</b> Each term	<b>Duration</b> 1 term	<b>Language</b> German/English	<b>Level</b> 4	<b>Version</b> 4
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<b>Mandatory</b>			
T-PHYS-109617	<a href="#">Scientific Concept Development</a>	30 CR	

**Competence Certificate****Module examination: Coursework (“Studienleistung”)**

Examination of other type in accordance to §4(2) No. 3 SPO Master’s Meteorology:

Final presentation (20-25 minutes) in the *Seminar on Specialization Phase*, followed by a short discussion with the audience (15 minutes). Afterwards a short feedback meeting with the examiners and the supervisor about the progress and next steps will take place.

**Competence Goal**

Students are able to work on a meteorological or interdisciplinary research project using scientific methods.

They can, with guidance, plan, structure, prepare, conduct a study and document their results complete and comprehensible. In doing so, they follow the rules of citing their own or others' prior work or previously published results.

They can select appropriate methods for the solution of the given problem.

Students are able to work self-organized and structured. They possess skills in the field of project management and presentation, both orally and in writing.

**Prerequisites**

Students need to have successfully completed all four module exams in the subjects *Atmospheric and Climate Processes* and *Applied and Experimental Meteorology*.

*Soft skills* and complementary elective can still be incomplete.

**Content**

Conducting a meteorological, interdisciplinary project work. This may be of a theoretical and/or experimental type. The focus is on the development of conclusions using scientific methods, project management and presentation of the results.

Students are invited to make suggestions for topics.

It is possible to conduct the project in cooperation with external partners.

**Workload**

Independent scientific work: 820 hours

Preparation Lecture and presence in the accompanying seminar: 80 hours


## 7 Courses

T

### 7.1 Course: Advanced Fluid Mechanics [T-BGU-106612]

**Responsible:** Prof. Dr. Olivier Eiff  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [M-BGU-105504 - Fluid Mechanics and Turbulence](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each term	1

Events					
ST 2021	6221701	<a href="#">Advanced Fluid Mechanics</a>	4 SWS	Lecture / Practice ( / ) 	Eiff
Exams					
ST 2021	8244106612	<a href="#">Advanced Fluid Mechanics</a>			Eiff
WT 21/22	8244106612	<a href="#">Advanced Fluid Mechanics</a>			Eiff

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

#### Competence Certificate

written exam, 90 min.

#### Prerequisites

none

#### Recommendation

none

#### Annotation



none





## T

## 7.2 Course: Advanced Numerical Weather Prediction [T-PHYS-109139]

**Responsible:** Prof. Dr. Peter Knippertz  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100954 - Applied Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Events					
ST 2021	4052051	<a href="#">Advanced Numerical Weather Prediction</a>	2 SWS	Lecture / 	Knippertz
ST 2021	4052052	<a href="#">Exercises to Advanced Numerical Weather Prediction</a>	2 SWS	Practice / 	Knippertz, Burba, Borne
Exams					
ST 2021	7800017	<a href="#">Advanced Numerical Weather Prediction (Prerequisite)</a>			Ginete Werner Pinto

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none

Below you will find excerpts from events related to this course:

## V

**Advanced Numerical Weather Prediction**

4052051, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
Online**

**Content**

- Introduction
- Parametrizations
- Data assimilation
- Ensemble predictions
- Verification
- Post-processing

**Organizational issues**


- Please register for the ILIAS course to receive further information





## T

## 7.3 Course: Advanced Practical Courses [T-PHYS-109135]

**Responsible:** Dr. Michael Höpfner  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100953 - Experimental Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Events					
ST 2021	4052103	<a href="#">Advanced Meteorological Practical Course</a>	5 SWS	Practical course / 	NN, Wagner, Höpfner, Kohler
Exams					
ST 2021	7800026	<a href="#">Advanced Meteorological Practical Course</a>			Sinnhuber

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Timely delivery and confirmation of the internship evaluation.

**Prerequisites**

None

*Below you will find excerpts from events related to this course:*

## V

**Advanced Meteorological Practical Course**

4052103, SS 2021, 5 SWS, Language: English, [Open in study portal](#)

**Practical course (P)  
On-Site**

**Content**

Available experiments include:

- surface energy balance (IMK-TRO)
- infrared spectroscopy (IMK-ASF)
- AIDA cloud and aerosol chamber (IMK-AAF)

**Organizational issues**

- AIDA: 19-23 July 2021, Introduction at the end of May/beginning of June
- Energy balance: 06-10 July 2021
- FTIR: May/June (TBD)

Please register for the ILIAS course to receive further information.



## T

**7.4 Course: Applied Meteorology (Module Exam) [T-PHYS-109143]****Responsible:** Prof. Dr. Joaquim José Ginete Werner Pinto**Organisation:** KIT Department of Physics**Part of:** [M-PHYS-100954 - Applied Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	10	Grade to a third	Each summer term	4

Exams			
ST 2021	7800023	<a href="#">Examination on Applied Meteorology (Module Exam)</a>	Ginete Werner Pinto
WT 21/22	7800069	<a href="#">Applied Meteorology (Module Exam)</a>	Kunz

**Competence Certificate**

The awarding of 10 credits will take place after passing the oral exam (see module description).

**Prerequisites**

It is only possible to register for the examination if the academic achievement "methods of data analysis" and further study achievements have been achieved to a sufficient degree.

**Modeled Conditions**

The following conditions have to be fulfilled:

1. You have to fulfill 2 of 3 conditions:
  1. The course [T-PHYS-109141 - Energy Meteorology](#) must have been passed.
  2. The course [T-PHYS-109139 - Advanced Numerical Weather Prediction](#) must have been passed.
  3. The course [T-PHYS-108610 - Turbulent Diffusion](#) must have been passed.
2. The course [T-PHYS-109142 - Methods of Data Analysis](#) must have been passed.

T

**7.5 Course: Atmospheric Aerosols [T-PHYS-108938]**

**Responsible:** Dr. Ottmar Möhler  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100952 - Atmospheric Processes](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each winter term	1

Events					
WT 21/22	4052041	<a href="#">Atmospheric Aerosols</a>	2 SWS	Lecture /	Möhler
WT 21/22	4052042	<a href="#">Exercises to Atmospheric Aerosols</a>	1 SWS	Practice /	Möhler, Bogert
Exams					
WT 21/22	7800083	<a href="#">Atmospheric Aerosols (Prerequisite)</a>			Hoose

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Prerequisites**

None

Below you will find excerpts from events related to this course:

V

**Atmospheric Aerosols**

4052041, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Gas particle processes (kinetics, diffusion, condensation), aerosol properties (diffusion, coagulation, sedimentation, impaction), aerosol thermodynamics (chemical potential, solubility, crystallization), aerosol cloud processes (Köhler theory, ice nucleation).

**Organizational issues**

Please sign up for more information in the Ilias course.

T

**7.6 Course: Atmospheric Processes (Module Exam) [T-PHYS-108939]**

**Responsible:** Prof. Dr. Corinna Hoose  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100952 - Atmospheric Processes](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	12	Grade to a third	Each term	1

Exams			
ST 2021	7800016	<a href="#">Examination on Atmospheric Processes (Module Exam)</a>	Hoose
WT 21/22	7800039	<a href="#">Examination on Atmospheric Processes (Module Exam)</a>	Hoose

**Prerequisites**

All module courses must be passed.

**Modeled Conditions**

The following conditions have to be fulfilled:


1. The course [T-PHYS-107694 - Cloud Physics](#) must have been passed.
2. The course [T-PHYS-107696 - Atmospheric Radiation](#) must have been passed.
3. The course [T-PHYS-107695 - Energetics](#) must have been passed.
4. The course [T-PHYS-108938 - Atmospheric Aerosols](#) must have been passed.





## T

## 7.7 Course: Atmospheric Radiation [T-PHYS-107696]

**Responsible:** Dr. Michael Höpfner  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100952 - Atmospheric Processes](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each winter term	1

Events					
WT 21/22	4052071	<a href="#">Atmospheric Radiation</a>	2 SWS	Lecture / 	Höpfner, Järvinen
Exams					
WT 21/22	7800106	<a href="#">Atmospheric Radiation (Prerequisite)</a>			Hoose

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

none

*Below you will find excerpts from events related to this course:*

## V

**Atmospheric Radiation**

4052071, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
Online**

**Content**

- Relevance: Weather/Climate, Chemistry, Remote Sensing
- Short history of light
- Properties of electromagnetic radiation
- Radiometric quantities
- The electromagnetic spectrum
- Boundary conditions: Sun, Earth's surface; reflection and emission
- Radiative transfer in the thermal infrared region: black body radiation, local/non-local thermodynamic equilibrium, transmission, radiative transfer, application in remote sensing
- Molecular spectroscopy, line-broadening
- Radiative transfer in the UV/Visible: absorption and scattering by particles
- Single scattering properties: Rayleigh, Mie-approximations
- Optical phenomena: rainbows, halos
- Radiative transfer with multiple scattering: why are clouds white?, two-stream approximation
- Radiative budget, climate engineering

**Organizational issues**

Please sign up for more information in the Ilias course.

T

## 7.8 Course: Basics of Estimation Theory and its Application in Geoscience Remote Sensing [T-BGU-106822]

**Responsible:** Prof. Dr. Jan Cermak  
Prof. Dr.-Ing. Stefan Hinz

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-103422 - Basics of Estimation Theory and its Application in Geoscience Remote Sensing](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	5	Grade to a third	Each summer term	1

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-BGU-106821 - Basics of Estimation Theory, Prerequisite](#) must have been passed.
2. The course [T-BGU-106633 - Data Analysis in Geoscience Remote Sensing Projects, Prerequisite](#) must have been passed.

T

**7.9 Course: Basics of Estimation Theory, Prerequisite [T-BGU-106821]****Responsible:** Prof. Dr.-Ing. Stefan Hinz**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences**Part of:** [M-BGU-103422 - Basics of Estimation Theory and its Application in Geoscience Remote Sensing](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	1

T

## 7.10 Course: Building and Environmental Aerodynamics [T-BGU-111060]

**Responsible:** Dr.-Ing. Christof-Bernhard Gromke  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [M-BGU-105504 - Fluid Mechanics and Turbulence](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each term	1 terms	1

Events					
WT 21/22	6221905	<a href="#">Building and Environmental Aerodynamics</a>	2 SWS	Lecture / Practice (	Gromke
Exams					
ST 2021	8244111060	<a href="#">Building and Environmental Aerodynamics</a>			Gromke
WT 21/22	8244111060	<a href="#">Building and Environmental Aerodynamics</a>			Gromke

### Competence Certificate

oral exam, appr. 30 min.

### Prerequisites

none

### Recommendation

none

### Annotation

none

## T

## 7.11 Course: Climate Modeling &amp; Dynamics with ICON [T-PHYS-108928]

**Responsible:** Prof. Dr. Joaquim José Ginete Werner Pinto  
Dr. Aiko Voigt

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-100951 - Components of the Climate System](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each winter term	1

Events					
WT 21/22	4052151	<a href="#">Climate Modeling &amp; Dynamics with ICON</a>	2 SWS	Lecture / 🗎	Ginete Werner Pinto, Ludwig
WT 21/22	4052152	<a href="#">Exercises to Climate Modeling &amp; Dynamics with ICON</a>	1 SWS	Practice / 🗎	Ginete Werner Pinto, Lemburg, Breil
Exams					
WT 21/22	7800087	<a href="#">Climate Modeling &amp; Dynamics with ICON (Prerequisite)</a>			Fink, Ginete Werner Pinto

Legend: 🗎 Online, 🗎 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**

Successful participation in the exercises.

**Prerequisites**

None

Below you will find excerpts from events related to this course:

## V

**Climate Modeling & Dynamics with ICON**

4052151, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Introduction to the ICON model, baroclinic life cycles, cloud impact on large-scale circulation of the atmosphere, climate change response of extra tropical jet stream, aerosol impact on tropical rain belts.

Numerical modeling and analysis of climate and climate change (climate system, conceptual models for processes and feedback, chaotic dynamic systems, numerical climate models (EMICS, Global models, regional models), (statistical) analysis methods.

**Organizational issues**

Please sign up for more information in the Ilias course.



T

## 7.12 Course: Cloud Physics [T-PHYS-107694]

**Responsible:** Prof. Dr. Corinna Hoose  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100952 - Atmospheric Processes](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each winter term	1

Events					
WT 21/22	4052081	<a href="#">Cloud Physics</a>	2 SWS	Lecture / 📺	Hoose
WT 21/22	4052082	<a href="#">Exercises to Cloud Physics</a>	1 SWS	Practice / 🎧	Hoose, Jung
Exams					
WT 21/22	7800105	<a href="#">Cloud Physics (Prerequisite)</a>			Hoose

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🎧 On-Site, ✕ Cancelled

**Competence Certificate**

More than 50% of the points from the exercises must be achieved and at least 1x must be pre-calculated.

**Prerequisites**

none

Below you will find excerpts from events related to this course:

V

**Cloud Physics**

4052081, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
Online**

**Content**

Phenomenology, cloud dynamics of stratiform and convective clouds, micro physics of warm and cold clouds, collision and coalescence, primary and secondary ice formation, condensational and depositional growth.

**Organizational issues**

Please sign up for more information in the Ilias course.

## T

**7.13 Course: Components of the Climate System (Module Exam) [T-PHYS-108933]**

**Responsible:** Prof. Dr. Andreas Fink  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100951 - Components of the Climate System](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	12	Grade to a third	Each winter term	2

Exams			
ST 2021	7800015	<a href="#">Examination on Components of the Climate System (Module Exam)</a>	Fink
WT 21/22	7800045	<a href="#">Components of the Climate System (Module Exam)</a>	Fink

**Competence Certificate**

The allocation of 12 credits takes place after passing the oral exam (see module description).

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The following conditions have to be fulfilled:
  1. You have to fulfill 2 of 3 conditions:
    1. The course [T-PHYS-108931 - Middle Atmosphere in the Climate System](#) must have been passed.
    2. The course [T-PHYS-108932 - Ocean-Atmosphere Interactions](#) must have been passed.
    3. The course [T-PHYS-107692 - Seminar on IPCC Assessment Report](#) must have been passed.
  2. The course [T-PHYS-107693 - Tropical Meteorology](#) must have been passed.
  3. The course [T-PHYS-108928 - Climate Modeling & Dynamics with ICON](#) must have been passed.

T

## 7.14 Course: Data Analysis in Geoscience Remote Sensing Projects, Prerequisite [T-BGU-106633]

**Responsible:** Prof. Dr. Jan Cermak

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-103422 - Basics of Estimation Theory and its Application in Geoscience Remote Sensing](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	2

Exams			
ST 2021	8297106633	<a href="#">Data Analysis in Geoscience Remote Sensing Projects, Prerequisite</a>	Cermak, Andersen

### Competence Certificate

The assessment consists of a coursework according § 4 para. 3 SPO M.Sc. Geodäsie und Geoinformatik based on successful elaboration of exercises and on data analysis of a geoscientific question and written report of about 8 pages of the results. The detailed conditions will be announced in the lecture.

### Prerequisites

None

### Recommendation

None

### Annotation

None

T


**7.15 Course: Data Science I [T-INFO-111622]**





**Responsible:** Prof. Dr.-Ing. Klemens Böhm  
Dr.-Ing. Edouard Fouché

**Organisation:** KIT Department of Informatics

**Part of:** [M-INFO-102980 - Informatics for Meteorology Students](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	5	Grade to a third	Each winter term	2

Events					
WT 21/22	24114	<a href="#">Data Science 1</a>	3 SWS	Lecture / 	Fouché



Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled





T

## 7.16 Course: Database Systems [T-INFO-101497]

**Responsible:** Prof. Dr.-Ing. Klemens Böhm  
**Organisation:** KIT Department of Informatics  
**Part of:** [M-INFO-102980 - Informatics for Meteorology Students](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	1

Events					
ST 2021	24516	<a href="#">Datenbanksysteme</a>	2 SWS	Lecture / 	Böhm, Mülle
ST 2021	24522	<a href="#">Übungen zu Datenbanksysteme</a>	1 SWS	Practice / 	Böhm, Mülle
Exams					
ST 2021	7500166	<a href="#">Database Systems</a>			Böhm
WT 21/22	7500189	<a href="#">Database Systems</a>			Böhm

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

T

**7.17 Course: Distributed Computing [T-INFO-101298]**

**Responsible:** Prof. Dr. Achim Streit  
**Organisation:** KIT Department of Informatics  
**Part of:** [M-INFO-102980 - Informatics for Meteorology Students](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	2

Events					
WT 21/22	2400050	<a href="#">Distributed Computing</a>	2 SWS	Lecture	Streit, Krauß, Kühn
Exams					
ST 2021	7500282	<a href="#">Distributed Computing</a>			Streit
WT 21/22	7500172	<a href="#">Distributed Computing</a>			Streit

## T 7.18 Course: Energetics [T-PHYS-107695]

**Responsible:** Prof. Dr. Andreas Fink  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100952 - Atmospheric Processes](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each winter term	1

Events					
WT 21/22	4052131	<a href="#">Energetics</a>	2 SWS	Lecture / 🗣️	Fink
Exams					
WT 21/22	7800107	<a href="#">Energetics (Prerequisite)</a>			Hoose

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✕ Cancelled

### Prerequisites

none

Below you will find excerpts from events related to this course:

**V Energetics**  
 4052131, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
On-Site**

### Content

Mean meridional circulation, stationary and transient eddies; basic forms, budget equations and transport processes of energy in the atmosphere; principle of available potential energy; Lorenz cycle: energy reservoirs and transformation processes, eddy and thermally driven jets (EP flux vectors).

### Table of content:

- Literature & Learning goals
- The Climate System
- Basic Equations of the Climate System
- Decomposition of the general circulation
- Radiation budget and energy transports
- Consequences of the radiation and surface energy budgets
- Atmospheric water budget
- Atmospheric and oceanic energy budget
- Concept of „Available Potential Energy (APE)“

### Organizational issues

Please sign up for more information in the Ilias course.

T


**7.19 Course: Energy Meteorology [T-PHYS-109141]**

**Responsible:** apl. Prof. Dr. Stefan Emeis  
Prof. Dr. Joaquim José Ginete Werner Pinto

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-100954 - Applied Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Events					
ST 2021	4052191	<a href="#">Energy Meteorology</a>	2 SWS	Lecture / 	Emeis, Schroedter-Homscheidt, Ginete Werner Pinto
Exams					
ST 2021	7800021	<a href="#">Energy Meteorology</a>			Ginete Werner Pinto

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

None

Below you will find excerpts from events related to this course:

V

**Energy Meteorology**

4052191, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
Online**

**Content**

- Overview Energy Meteorology
- Physical basics – Wind energy
- Physical basics of energy supply
- Economic basics of energy supply
- Onshore and offshore wind parks
- Wind energy siting – complex terrain
- Physical basics – Solar energy
- Tracking and concentrating solar systems
- Wind measurements
- Radiation forecasts
- Wind energy – yield forecasts
- Climate change & energy system
- Community energy meteorology and where to work

**Organizational issues**

- 26 - 30 July 2021
- Please register for the ILIAS course to receive further information



T

**7.20 Course: Exam on Physics of Planetary Atmospheres [T-PHYS-109180]**

**Responsible:** Prof. Dr. Thomas Leisner  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-104488 - Physics of Planetary Atmospheres](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	2	Grade to a third	Each winter term	1

Exams			
WT 21/22	7800092	<a href="#">Physics of Planetary Atmospheres (Exam)</a>	Leisner

**Prerequisites**

None

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-PHYS-109177 - Physics of Planetary Atmospheres](#) must have been passed.

T

**7.21 Course: Experimental Meteorology (Module Exam) [T-PHYS-109137]**

**Responsible:** Dr. Björn-Martin Sinnhuber  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100953 - Experimental Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	14	Grade to a third	Each summer term	3

Exams			
ST 2021	7800038	<a href="#">Examination on Experimental Meteorology (Module Exam)</a>	Sinnhuber

**Competence Certificate**

The allocation of 12 credits takes place after passing the oral exam (see module description).

**Prerequisites**

In the Module "Experimental Meteorology" all offered courses must be passed.

**Modeled Conditions**

The following conditions have to be fulfilled:


1. The course [T-PHYS-109135 - Advanced Practical Courses](#) must have been passed.
2. The course [T-PHYS-109136 - Field Trip](#) must have been passed.
3. The course [T-PHYS-109902 - Integrated Atmospheric Measurements](#) must have been passed.
4. The course [T-PHYS-111274 - Remote Sensing of Atmosphere and Ocean](#) must have been passed.





T

**7.22 Course: Field Course Soil Science [T-BGU-107486]**

**Responsible:** Prof. Dr. Wolfgang Wilcke  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [M-BGU-103398 - Geoecology](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	1

Events					
ST 2021	6111077	<a href="#">Field Course Soil Science</a>	1 SWS	Practice / 	Velescu
Exams					
ST 2021	8262101508	<a href="#">Field Course Soil Science</a>			Velescu, Stock

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

None

**Recommendation**

None

**Annotation**

None

T

## 7.23 Course: Field Trip [T-PHYS-109136]

**Responsible:** Prof. Dr. Corinna Hoose  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100953 - Experimental Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Events					
ST 2021	4052263	<a href="#">Field Trip</a>	2 SWS	Excursion (E / 🗺️)	Hoose, Klose
Exams					
ST 2021	7800037	<a href="#">Field Trip</a>			Sinnhuber

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗺️ On-Site, ✖ Canceled

**Competence Certificate**

Lectures on specific topics about the excursion

**Prerequisites**

None

*Below you will find excerpts from events related to this course:*

V

**Field Trip**

4052263, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Excursion (EXK)  
On-Site**

**Content**

The course comprises a one-week excursion to research institutes and observatories in Germany and neighbouring countries.

**Organizational issues**


- The date for the field trip will be arranged in the semester opening on April 12th, 11:00 - 12:00
- Please register for the ILIAS course to receive further information

T

## 7.24 Course: Flow Measurement Techniques [T-BGU-110411]

**Responsible:** Dr.-Ing. Christof-Bernhard Gromke  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [M-BGU-105504 - Fluid Mechanics and Turbulence](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each term	1 terms	1

Events					
WT 21/22	6221907	<a href="#">Flow Measurement Techniques</a>	2 SWS	Lecture / Practice ( /  )	Gromke
Exams					
ST 2021	8244110411	<a href="#">Flow Measurement Techniques</a>			Gromke
WT 21/22	8244110411	<a href="#">Flow Measurement Techniques</a>			Gromke

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam, appr. 30 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**


none

T

## 7.25 Course: Fluid Mechanics of Turbulent Flows [T-BGU-110841]

**Responsible:** Prof. Dr.-Ing. Markus Uhlmann  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [M-BGU-105504 - Fluid Mechanics and Turbulence](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	1

Events					
ST 2021	6221806	<a href="#">Fluid Mechanics of Turbulent Flows</a>	4 SWS	Lecture / Practice ( / 	Uhlmann
Exams					
ST 2021	8244110841	<a href="#">Fluid Mechanics of Turbulent Flows</a>			Uhlmann
WT 21/22	8244110841	<a href="#">Fluid Mechanics of Turbulent Flows</a>			Uhlmann

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

oral exam, appr. 45 min.

**Prerequisites**

none

**Recommendation**

none

**Annotation**

none

T



## 7.26 Course: Geo Data Infrastructures and Web Services [T-BGU-101756]





**Responsible:** Dr.-Ing. Sven Wursthorn

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-102760 - GIS and Geo Data Infrastructures](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	1	Grade to a third	Each summer term	2

Events					
ST 2021	6026204	<a href="#">Geodateninfrastrukturen und Webdienste</a>	1 SWS	Lecture / 	Wursthorn
ST 2021	6026205	<a href="#">Geodateninfrastrukturen und Webdienste, Übung</a>	2 SWS	Practice / 	Wursthorn
Exams					
ST 2021	8296101756	<a href="#">Geo Data Infrastructures and Web Services</a>	Wursthorn		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Prerequisites

The part T-BGU-101757 [Geodateninfrastrukturen und Web-Dienste](#), Vorleistung has to be passed.

### Modeled Conditions



The following conditions have to be fulfilled:





1. The course [T-BGU-101757 - Geodata Infrastructures and Web-Services](#), [Prerequisite](#) must have been passed.

T

**7.27 Course: Geodata Infrastructures and Web-Services, Prerequisite [T-BGU-101757]****Responsible:** Dr.-Ing. Sven Wursthorn**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences**Part of:** [M-BGU-102760 - GIS and Geo Data Infrastructures](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each summer term	2

Events					
ST 2021	6026204	<a href="#">Geodateninfrastrukturen und Webdienste</a>	1 SWS	Lecture / 	Wursthorn
ST 2021	6026205	<a href="#">Geodateninfrastrukturen und Webdienste, Übung</a>	2 SWS	Practice / 	Wursthorn
Exams					
ST 2021	8296101757	<a href="#">Geodata Infrastructures and Web-Services, Prerequisite</a>	Wursthorn		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**

None



T

**7.28 Course: Geological Hazards and Risk [T-PHYS-103525]**

**Responsible:** Dr. Ellen Gottschämmer  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-101833 - Geological Hazards and Risk](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each winter term	2


Events					
WT 21/22	4060121	<a href="#">Geological Hazards and Risk</a>	2 SWS	Lecture	Gottschämmer, Daniell
WT 21/22	4060122	<a href="#">Exercises on Geological Hazards and Risk</a>	2 SWS	Practice	Gottschämmer, Daniell
Exams					
WT 21/22	7800114	<a href="#">Geological Hazards and Risk</a>			Gottschämmer





T

## 7.29 Course: Geomorphology and Soil Science [T-BGU-107487]

**Responsible:** Prof. Dr. Wolfgang Wilcke  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [M-BGU-103398 - Geoecology](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	7	Grade to a third	Each summer term	1

Events					
ST 2021	6111071	<a href="#">Soils of Europe</a>	2 SWS	Lecture / 	Wilcke
WT 21/22	6111061	<a href="#">Geomorphology and Pedology</a>	2 SWS	Lecture	Norra, Wilcke
WT 21/22	6111066	<a href="#">Geomorphologie und Bodenkunde</a>	1 SWS	Practice	Velescu, Stock
Exams					
ST 2021	8262101507_1	<a href="#">Geomorphology and Soil Science</a>			Wilcke
ST 2021	8262101507_2	<a href="#">Geomorphology and Soil Science</a>			Wilcke

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Prerequisites**

None

**Recommendation**

None

**Annotation**

None

## T

**7.30 Course: Image Processing and Computer Vision [T-BGU-101732]**

**Responsible:** Dr.-Ing. Uwe Weidner  
**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences  
**Part of:** [M-BGU-102757 - Computer Vision and GIS](#)  
[M-BGU-102759 - Computer Vision and Remote Sensing](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 21/22	6042101	<a href="#">Image Processing and Computer Vision, Lecture</a>	2 SWS	Lecture	Weinmann, Weidner
WT 21/22	6042102	<a href="#">Image Processing and Computer Vision, Exercises</a>	1 SWS	Practice	Weinmann, Weidner
Exams					
WT 21/22	8291101732	<a href="#">Image Processing and Computer Vision</a>	Weidner		

**Competence Certificate**

The assessment consists of a oral exam (ca. 30 min). according § 4 para. 2 No. 2 SPO M.Sc. Geodäsie und Geoinformatik.

**Prerequisites**

The parts T-BGU-106333 und T-BGU-106334 must not have started.

**Modeled Conditions**

The following conditions have to be fulfilled:


1. The course [T-BGU-106333 - Remote Sensing of a Changing Climate, Prerequisite](#) must not have been started.
2. The course [T-BGU-106334 - Remote Sensing of a Changing Climate, Examination](#) must not have been started.





T

## 7.31 Course: Integrated Atmospheric Measurements [T-PHYS-109902]

**Responsible:** Carolin Schmitt  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100953 - Experimental Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	1

Events					
ST 2021	4052131	<a href="#">Integrated Atmospheric Measurements</a>	2 SWS	Lecture / 	Schmitt
Exams					
ST 2021	7800110	<a href="#">Integrated Atmospheric Measurements (Prerequisite)</a>			Sinnhuber

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Prerequisites

None

Below you will find excerpts from events related to this course:

V

## Integrated Atmospheric Measurements

4052131, SS 2021, 2 SWS, [Open in study portal](#)

Lecture (V)  
Online

### Content

Brief Introduction to advanced atmospheric observation techniques like eddy covariance measurements, Doppler Lidar, Doppler Radar and aircraft measurements. Principle and objectives of Integrated Observation. Examples of Integrated Observation from Polar Research, Convection Studies and Orographic Flow analysis.

### Organizational issues

- Please register for the ILIAS course to receive further information

T

## 7.32 Course: Introduction into Classification Methods of Remote Sensing [T-BGU-105725]

**Responsible:** Dr.-Ing. Uwe Weidner

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-102758 - GIS and Remote Sensing](#)  
[M-BGU-102759 - Computer Vision and Remote Sensing](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Exams			
ST 2021	8296105725	<a href="#">Introduction into Classification Methods of Remote Sensing</a>	Weidner

### Competence Certificate

oral exam (approx. 20 min.)

### Prerequisites

None

### Recommendation

None

### Annotation

None

T

## 7.33 Course: Introduction to GIS for Students of Natural, Engineering and Geo Sciences [T-BGU-101681]

**Responsible:** Dr.-Ing. Norbert Rösch  
Dr.-Ing. Sven Wursthorn

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-102757 - Computer Vision and GIS](#)  
[M-BGU-102758 - GIS and Remote Sensing](#)  
[M-BGU-102760 - GIS and Geo Data Infrastructures](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each winter term	1

Events					
WT 21/22	6071101	<a href="#">Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen, V/Ü</a>	4 SWS	Lecture / Practice (	Rösch, Wursthorn
Exams					
ST 2021	8280101681	<a href="#">Introduction to GIS for Students of Natural, Engineering and Geo Sciences</a>			Wursthorn
WT 21/22	8280101681	<a href="#">Introduction to GIS for Students of Natural, Engineering and Geo Sciences</a>			Rösch, Wursthorn

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-BGU-103541 - Introduction to GIS for Students of Natural, Engineering and Geo Sciences](#), Prerequisite must have been passed.

T

## 7.34 Course: Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite [T-BGU-103541]

**Responsible:** Dr.-Ing. Norbert Rösch  
Dr.-Ing. Sven Wursthorn

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-102757 - Computer Vision and GIS](#)  
[M-BGU-102758 - GIS and Remote Sensing](#)  
[M-BGU-102760 - GIS and Geo Data Infrastructures](#)



Type	Credits	Grading scale	Recurrence	Version
Completed coursework	3	pass/fail	Each winter term	2





Events					
WT 21/22	6071101	Einführung in GIS für Studierende natur-, ingenieur- und geowissenschaftlicher Fachrichtungen, V/Ü	4 SWS	Lecture / Practice (	Rösch, Wursthorn
Exams					
ST 2021	8280103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences			Wursthorn
WT 21/22	8280101681	Introduction to GIS for Students of Natural, Engineering and Geo Sciences			Rösch, Wursthorn
WT 21/22	8280103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences			Rösch, Wursthorn

T

**7.35 Course: Introduction to Volcanology, Exam [T-PHYS-103644]****Responsible:** Dr. Ellen Gottschämmer**Organisation:** KIT Department of Physics**Part of:** [M-PHYS-103336 - Geophysical analysis of natural hazards](#)

Type	Credits	Grading scale	Version
Examination of another type	1	Grade to a third	1

Events					
ST 2021	4060251	<a href="#">Introduction to Volcanology</a>	1 SWS	Lecture / 	Gottschämmer, Rietbrock
ST 2021	4060252	<a href="#">Exercises to Introduction to Volcanology</a>	1 SWS	Practice / 	Gottschämmer, Rietbrock
Exams					
ST 2021	7800044	<a href="#">Introduction to Volcanology, exam</a>			Gottschämmer

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Modeled Conditions**



The following conditions have to be fulfilled:





1. The course [T-PHYS-103553 - Introduction to Volcanology, Prerequisite](#) must have been passed.



T

**7.36 Course: Introduction to Volcanology, Prerequisite [T-PHYS-103553]****Responsible:** Dr. Ellen Gottschämmer**Organisation:** KIT Department of Physics**Part of:** [M-PHYS-103336 - Geophysical analysis of natural hazards](#)**Type**  
Completed coursework**Credits**  
3**Grading scale**  
pass/fail**Version**  
1

Events					
ST 2021	4060251	<a href="#">Introduction to Volcanology</a>	1 SWS	Lecture / 	Gottschämmer, Rietbrock
ST 2021	4060252	<a href="#">Exercises to Introduction to Volcanology</a>	1 SWS	Practice / 	Gottschämmer, Rietbrock
Exams					
ST 2021	7800043	<a href="#">Introduction to Volcanology, Studienleistung</a>			Gottschämmer

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

T

**7.37 Course: Master`s Thesis [T-PHYS-109616]**

**Responsible:** Prof. Dr. Corinna Hoose  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100956 - Master Thesis](#)

Type	Credits	Grading scale	Recurrence	Version
Final Thesis	30	Grade to a third	Each term	1

**Prerequisites**

see module information

**Final Thesis**

This course represents a final thesis. The following periods have been supplied:

**Submission deadline** 6 months  
**Maximum extension period** 3 months  
**Correction period** 8 weeks

This thesis requires confirmation by the examination office.

T



**7.38 Course: Methods of Data Analysis [T-PHYS-109142]**





**Responsible:** Prof. Dr. Joaquim José Ginete Werner Pinto  
Prof. Dr. Peter Knippertz

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-100954 - Applied Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	2

Events					
ST 2021	4052171	<a href="#">Methods of Data Analysis</a>	2 SWS	Lecture / 	Ginete Werner Pinto, Lerch
ST 2021	4052172	<a href="#">Exercises to Methods of Data Analysis</a>	1 SWS	Practice / 	Ginete Werner Pinto, Ehmele
Exams					
ST 2021	7800022	<a href="#">Methods of Data Analysis (Prerequisite)</a>	Ginete Werner Pinto		

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

Successful participation in the exercises.

**Prerequisites**

None

Below you will find excerpts from events related to this course:

V

**Methods of Data Analysis**

4052171, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
Online**

**Content**

1. Basics
2. Significance testings
3. Regression
4. Time series
5. Fourier wavelet analysis
6. Spatial analysis
7. Clustering
8. Machine Learning
9. Summary

**Organizational issues**

Organisatorisches:

- First meeting: 13.4. at 10:00 via zoom
- Please register for the ILIAS course to receive further information

V

**Exercises to Methods of Data Analysis**

4052172, SS 2021, 1 SWS, Language: English, [Open in study portal](#)

**Practice (Ü)  
Online**

**Content**

Following the lecture.

T

**7.39 Course: Middle Atmosphere in the Climate System [T-PHYS-108931]**

**Responsible:** Dr. Michael Höpfner  
Dr. Miriam Sinnhuber

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-100951 - Components of the Climate System](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Irregular	1

Events					
WT 21/22	4052061	<a href="#">Middle Atmosphere in the Climate System</a>	2 SWS	Lecture /	Höpfner, Sinnhuber
Exams					
WT 21/22	7800008	<a href="#">Middle Atmosphere in the Climate System (Prerequisite)</a>			Fink

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Prerequisites**

None

Below you will find excerpts from events related to this course:

V

**Middle Atmosphere in the Climate System**

4052061, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)  
Online**

**Content**

- History of science of the middle atmosphere (MA)
- Mean state of the MA: temperature, wind, chemical composition
- Radiation: sun, radiative transfer, energy budget, photolysis
- Measurements: in-situ/remote sounding, ground-based, airborne/balloon, satellite
- Aerosols: stratospheric background aerosol layer, volcanic enhancement, polar stratospheric clouds, polar mesospheric clouds, meteoric dust
- Chemistry: general concepts, global ozone layer, polar ozone chemistry
- Dynamics: fundamental description, meridional circulation, equatorial circulation, waves and tides, stratospheric warmings, tracer and age-of-air, up-per troposphere/lower stratosphere, cross-tropopause transport
- Coupling and climate: chemistry-climate coupling, trends,

**Organizational issues**

Please sign up for more information in the Ilias course.

T

**7.40 Course: Mobile Computing and Internet of Things [T-INFO-102061]**

**Responsible:** Prof. Dr.-Ing. Michael Beigl  
**Organisation:** KIT Department of Informatics  
**Part of:** [M-INFO-102980 - Informatics for Meteorology Students](#)

**Type**  
Oral examination

**Credits**  
5

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

Events					
WT 21/22	2400051	<a href="#">Mobile Computing and Internet of Things</a>	2+1 SWS	Lecture / Practice (	Beigl
Exams					
ST 2021	7500107_0621	<a href="#">Mobile Computing and Internet of Things</a>			Beigl
ST 2021	7500107_0819	<a href="#">Mobile Computing and Internet of Things</a>			Beigl
WT 21/22	7500055	<a href="#">Mobile Computing and Internet of Things</a>			Beigl
WT 21/22	7500145	<a href="#">Mobile Computing and Internet of Things</a>			Beigl

## T

## 7.41 Course: Modern Theoretical Physics for Teacher Students [T-PHYS-103204]

**Responsible:** Dr. Robert Eder

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-101664 - Modern Theoretical Physics for Teacher Students](#)

**Type**  
Oral examination

**Credits**  
8

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
1

Events					
WT 21/22	4012131	<a href="#">Moderne Theoretische Physik für Lehramtskandidaten</a>	4 SWS	Lecture	Eder
WT 21/22	4012132	<a href="#">Übungen zu Moderne Theoretische Physik für Lehramtskandidaten</a>	2 SWS	Practice	Eder, NN
Exams					
WT 21/22	7800078	<a href="#">Modern Theoretical Physics for Teacher Students</a>			Eder, Klinkhamer, Gieseke
WT 21/22	7800079	<a href="#">Modern Theoretical Physics for Teacher Students - Reserve</a>			

#### Competence Certificate

Oral exam, approx. 45 min

#### Prerequisites

successful completion of the exercises

#### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-PHYS-103203 - Modern Theoretical Physics for Teacher Students - Prerequisite](#) must have been passed.

T

## 7.42 Course: Modern Theoretical Physics for Teacher Students - Prerequisite [T-PHYS-103203]

**Responsible:** Dr. Robert Eder

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-101664 - Modern Theoretical Physics for Teacher Students](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each winter term	1

Events					
WT 21/22	4012131	<a href="#">Moderne Theoretische Physik für Lehramtskandidaten</a>	4 SWS	Lecture	Eder
WT 21/22	4012132	<a href="#">Übungen zu Moderne Theoretische Physik für Lehramtskandidaten</a>	2 SWS	Practice	Eder, NN
Exams					
WT 21/22	7800077	<a href="#">Modern Theoretical Physics for Teacher Students - Prerequisite</a>			Eder

### Competence Certificate

Course achievement, successful completion of the exercises

### Prerequisites

none

T



## 7.43 Course: Modern Theoretical Physics I, Quantum Mechanics 1 [T-PHYS-105134]





**Responsible:** Studiendekan Physik

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-101707 - Modern Theoretical Physics I, Quantum Mechanics I](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2021	4010141	<a href="#">Moderne Theoretische Physik I (Theorie D, Quantenmechanik I)</a>	4 SWS	Lecture / 	Schmalian
ST 2021	4010142	<a href="#">Übungen zu Moderne Theoretische Physik I</a>	2 SWS	Practice / 	Schmalian, Willa, Gall
Exams					
ST 2021	7800060	<a href="#">Modern Theoretical Physics I, Quantum Mechanics 1 - oral Exam</a>			Mühlleitner
ST 2021	7800115	<a href="#">Modern Theoretical Physics I, Quantum Mechanics 1</a>			Mühlleitner

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Oral exam, approx. 45 min

### Prerequisites

successful completion of the exercises



T



## 7.44 Course: Modern Theoretical Physics I, Quantum Mechanics 1, Prerequisite 1 [T-PHYS-102317]





**Responsible:** Prof. Dr. Jörg Schmalian

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-101707 - Modern Theoretical Physics I, Quantum Mechanics I](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	1

Events					
ST 2021	4010141	<a href="#">Moderne Theoretische Physik I (Theorie D, Quantenmechanik I)</a>	4 SWS	Lecture / 	Schmalian
ST 2021	4010142	<a href="#">Übungen zu Moderne Theoretische Physik I</a>	2 SWS	Practice / 	Schmalian, Willa, Gall
Exams					
ST 2021	7800064	<a href="#">Modern Theoretical Physics I, Quantum Mechanics 1, Prerequisite 1 - Tutorial</a>			Schmalian

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

### Competence Certificate

Course achievement, successful completion of the exercises

### Prerequisites

none

T



## 7.45 Course: Numerical Methods - Exam [T-MATH-100803]





**Responsible:** apl. Prof. Dr. Peer Kunstmann  
 Prof. Dr. Michael Plum  
 Prof. Dr. Wolfgang Reichel

**Organisation:** KIT Department of Mathematics

**Part of:** [M-MATH-100536 - Numerical Methods](#)

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each summer term	1

Events					
ST 2021	0180300	<a href="#">Numerische Methoden (Elektrotechnik, Meteorologie, Geodäsie, Geoinformatik)</a>	2 SWS	Lecture / 	Anapolitanos
ST 2021	0180400	<a href="#">Übungen zu 0180300</a>	1 SWS	Practice / 	Anapolitanos
Exams					
ST 2021	0100056	<a href="#">Numerical Methods - Exam</a>			Anapolitanos, Kunstmann
WT 21/22	0100017	<a href="#">Numerical Methods - Exam</a>			Plum, Wugalter, Anapolitanos, Kunstmann

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

T

**7.46 Course: Ocean-Atmosphere Interactions [T-PHYS-108932]**

**Responsible:** Prof. Dr. Andreas Fink  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100951 - Components of the Climate System](#)

**Type**  
Completed coursework

**Credits**  
0

**Grading scale**  
pass/fail

**Recurrence**  
Irregular

**Version**  
1

Events					
WT 21/22	4052121	<a href="#">Ocean-Atmosphere Interactions</a>	2 SWS	Lecture / 🗣️	Fink, van der Linden
Exams					
WT 21/22	7800067	<a href="#">Ocean-Atmosphere Interactions (Prerequisite)</a>			Fink

Legend: 📺 Online, 🔄 Blended (On-Site/Online), 🗣️ On-Site, ✕ Cancelled

**Prerequisites**

None

Below you will find excerpts from events related to this course:

V

**Ocean-Atmosphere Interactions**

4052121, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

- Literature
- Learning goals
- Physical and chemical properties of the upper ocean layers
  - Properties of ocean waters
  - Salinity content and density
  - Temperature distribution in the ocean
  - Horizontal salinity distribution in the ocean
  - Vertical salinity distribution
  - Horizontal and vertical density distribution
  - Characteristic water masses in the oceans
  - Dissolved gases in the ocean
  - Molecular transport
  - Properties of humid air
  - Ocean surface and its immediate environment
- Wind-driven ocean surface currents
  - Equation of motion
  - Ekman' s solution of the equation of motion
  - Mass transport associated with the Ekman current
  - Up-welling in the ocean
  - Sverdrup regime
  - Westerly boundary current: Stommel' s contribution
  - Munk' s solution
- Ocean waves
  - Generation of ocean waves by wind
  - Description of ocean waves
  - Global view on ocean wave climates
  - Ocean wave modeling
  - Ocean wave measurements
- Summary

**Organizational issues**


Please sign up for more information in the Ilias course.





T

## 7.47 Course: Parallel Computer Systems and Parallel Programming [T-INFO-101345]

**Responsible:** Prof. Dr. Achim Streit  
**Organisation:** KIT Department of Informatics  
**Part of:** [M-INFO-102980 - Informatics for Meteorology Students](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2021	24617	<a href="#">Parallel computer systems and parallel programming</a>	2 SWS	Lecture / 	Streit, Häfner
Exams					
ST 2021	7500141	<a href="#">Parallel computer systems and parallel programming</a>			Streit
WT 21/22	7500241	<a href="#">Parallel computer systems and parallel programming</a>			Streit

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

## T

## 7.48 Course: Physics of Planetary Atmospheres [T-PHYS-109177]

**Responsible:** Prof. Dr. Thomas Leisner  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-104488 - Physics of Planetary Atmospheres](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	8	pass/fail	Each winter term	2

Events					
WT 21/22	4052161	<a href="#">Physics of Planetary Atmospheres</a>	2 SWS	/	Leisner
WT 21/22	4052162	<a href="#">Exercises to Physics of Planetary Atmospheres</a>	2 SWS	Practice /	Leisner, Duft
Exams					
WT 21/22	7800091	<a href="#">Physics of Planetary Atmospheres (Prerequisite)</a>			Leisner

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

### Competence Certificate

- If this module is part of the Specialization or Compulsory Subject, credits are earned through the associated exam (oral, written or otherwise).
- Otherwise, the exercises, computer exercises, internships or, if necessary, graduation lectures must be successfully completed.

### Prerequisites

None

### Recommendation

Basic knowledge of physics, physical chemistry and fluid dynamics at Bachelor level.

### Annotation

240 hours consisting of attendance times (60 hours), follow-up of the lecture incl. Exam preparation and editing exercises (180 hours).

*Below you will find excerpts from events related to this course:*

## V

### Physics of Planetary Atmospheres

4052161, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

Online

### Content

The module gives a broad introduction into the formation and properties of planets and their atmospheres and tries to constrain possible planetary atmospheres by applying fundamental principles of physics. In this respect, the module will focus on the planetary atmospheres in our solar system. Moreover, recently developed methods for the remote sensing of extra solar planets are introduced and the current understanding of their atmospheres is presented. A focus is the energy budget of planetary atmospheres, where clouds play a central role. Their formation and growth will be covered in a generalized fashion.

### Organizational issues

Please sign up for more information in the Ilias course.

T

## 7.49 Course: Remote Sensing of a Changing Climate, Examination [T-BGU-106334]

**Responsible:** Prof. Dr. Jan Cermak

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-102759 - Computer Vision and Remote Sensing](#)

**Type**  
Oral examination

**Credits**  
3

**Grading scale**  
Grade to a third

**Recurrence**  
Each winter term

**Version**  
3

Events					
WT 21/22	6043106	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Lecture</a>	2 SWS	Lecture	Cermak
WT 21/22	6043107	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Exercises</a>	1 SWS	Practice	Cermak
Exams					
ST 2021	8297106334	<a href="#">Remote Sensing of a Changing Climate, Examination</a>			Cermak
WT 21/22	8296106334	<a href="#">Remote Sensing in a Changing Climate, Examination</a>			Cermak

### Competence Certificate

Oral exam of about 20 min.

### Prerequisites

T-BGU-106333 (Remote Sensing in a Changing Climate, Vorleistung) passed

T-BGU-101732 (Image Processing and Computer Vision) must not have been started.

### Modeled Conditions

The following conditions have to be fulfilled:

1. The course [T-BGU-106333 - Remote Sensing of a Changing Climate, Prerequisite](#) must have been passed.
2. The course [T-BGU-101732 - Image Processing and Computer Vision](#) must not have been started.

### Recommendation

None

### Annotation

None

T

**7.50 Course: Remote Sensing of a Changing Climate, Prerequisite [T-BGU-106333]****Responsible:** Prof. Dr. Jan Cermak**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences**Part of:** [M-BGU-102759 - Computer Vision and Remote Sensing](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each winter term	1

Events					
WT 21/22	6043107	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Exercises</a>	1 SWS	Practice	Cermak
Exams					
WT 21/22	8296106333	<a href="#">Remote Sensing in a Changing Climate, Prerequisite</a>			Cermak

**Modeled Conditions**

The following conditions have to be fulfilled:



1. The course [T-BGU-101732 - Image Processing and Computer Vision](#) must not have been started.





## T

## 7.51 Course: Remote Sensing of Atmosphere and Ocean [T-PHYS-111274]

**Responsible:** Dr. Björn-Martin Sinnhuber  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100953 - Experimental Meteorology](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	0	pass/fail	Each summer term	1 terms	1

Events					
ST 2021	4052151	<a href="#">Remote Sensing of Atmosphere and Ocean</a>	2 SWS	Lecture / 	Sinnhuber
ST 2021	4052152	<a href="#">Exercises to Remote Sensing of Atmosphere and Ocean</a>	1 SWS	Practice / 	Sinnhuber
Exams					
ST 2021	7800024	<a href="#">Remote Sensing of Atmosphere and Ocean (Prerequisite)</a>			Sinnhuber

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

**Competence Certificate**

More than 50% of the points from the exercises must be achieved.

**Prerequisites**

None

Below you will find excerpts from events related to this course:

## V

**Remote Sensing of Atmosphere and Ocean**

4052151, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

Lecture (V)  
Online

**Content**

- physical basics
- radiation transfer
- inverse methods
- basics of satellite remote sensing
- techniques and applications

**Organizational issues**

- Please register for the ILIAS course to receive further information

## V

**Exercises to Remote Sensing of Atmosphere and Ocean**

4052152, SS 2021, 1 SWS, Language: English, [Open in study portal](#)

Practice (Ü)  
Online

**Content**

Following the lecture.

**Organizational issues**

- Please register for the ILIAS course to receive further information



T

## 7.52 Course: Satellite Climatology: Remote Sensing of a Changing Climate, Examination [T-BGU-110305]

**Responsible:** Prof. Dr. Jan Cermak

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-105095 - Satellite Climatology: Remote Sensing of a Changing Climate](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	3	Grade to a third	Each winter term	1 terms	1

Events					
WT 21/22	6043106	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Lecture</a>	2 SWS	Lecture	Cermak
WT 21/22	6043107	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Exercises</a>	1 SWS	Practice	Cermak
Exams					
ST 2021	8297110305	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Examination</a>			Cermak
WT 21/22	8297110305	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Examination</a>			Cermak

### Competence Certificate

Oral exam (about 20 min.) according § 4 para. 2 No. 2 SPO M.Sc. Geodäsie und Geoinformatik.

### Prerequisites

The part T-BGU-106334 - Remote Sensing of a Changing Climate, Prüfung must not have started.

The part T-BGU-110304 - Satellite Climatology: Remote Sensing of a Changing Climate, Prerequisite must be passed.

### Modeled Conditions

You have to fulfill one of 2 conditions:

1. The course [T-BGU-110304 - Satellite Climatology: Remote Sensing of a Changing Climate](#), Prerequisite must have been passed.
2. The course [T-BGU-101732 - Image Processing and Computer Vision](#) must not have been started.

T

## 7.53 Course: Satellite Climatology: Remote Sensing of a Changing Climate, Prerequisite [T-BGU-110304]

**Responsible:** Prof. Dr. Jan Cermak

**Organisation:** KIT Department of Civil Engineering, Geo- and Environmental Sciences

**Part of:** [M-BGU-105095 - Satellite Climatology: Remote Sensing of a Changing Climate](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	1	pass/fail	Each winter term	1 terms	1

Events					
WT 21/22	6043106	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Lecture</a>	2 SWS	Lecture	Cermak
WT 21/22	6043107	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Exercises</a>	1 SWS	Practice	Cermak
Exams					
WT 21/22	8297110304	<a href="#">Satellite Climatology: Remote Sensing of a Changing Climate, Prerequisite</a>			Cermak

### Competence Certificate

Elaboration (data analysis and evaluation) in the form of a commented Jupyter notebook. Success is assessed in the form of a coursework (§ 4 (3) SPO). The detailed conditions will be announced in the lecture.

### Prerequisites

The parts T-BGU-106333 - Remote Sensing of a Changing Climate, Vorleistung and T-BGU-101732 - Image Processing and Computer Vision must not have started.

### Modeled Conditions


The following conditions have to be fulfilled:





1. The course [T-BGU-106333 - Remote Sensing of a Changing Climate, Prerequisite](#) must not have been started.
2. The course [T-BGU-101732 - Image Processing and Computer Vision](#) must not have been started.

T

**7.54 Course: Scientific Concept Development [T-PHYS-109617]****Organisation:** KIT Department of Physics**Part of:** [M-PHYS-100955 - Specialisation Phase](#)

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	30	pass/fail	Each term	1 terms	1

Events					
ST 2021	4052904	<a href="#">Seminar on Specialization Phase</a>	2 SWS	Seminar / 	Braesicke, Fink, Hoose, Knippertz, Kunz, Leisner, Orphal, Ginete Werner Pinto
Exams					
ST 2021	7800098	<a href="#">Scientific Concept Development</a>			Hoose
WT 21/22	7800070	<a href="#">Scientific Concept Development</a>			Knippertz

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled**Prerequisites**

see module information or module handbook

**Modeled Conditions**

You have to fulfill one of 4 conditions:

1. The module [M-PHYS-100951 - Components of the Climate System](#) must have been passed.
2. The module [M-PHYS-100952 - Atmospheric Processes](#) must have been passed.
3. The module [M-PHYS-100953 - Experimental Meteorology](#) must have been passed.
4. The module [M-PHYS-100954 - Applied Meteorology](#) must have been passed.

*Below you will find excerpts from events related to this course:*

V

**Seminar on Specialization Phase**4052904, SS 2021, 2 SWS, Language: English, [Open in study portal](#)**Seminar (S)  
Online****Content**

In the Seminar on Specialization Phase students present their final theses in the context of the TL T-PHYS-109617 "Scientific Concept Development" (Master)

The registration takes place via Ilias and by mail to [katharina.maurer@kit.edu](mailto:katharina.maurer@kit.edu)

**Organizational issues**

- Please register for the ILIAS course to receive further information

T

## 7.55 Course: Seminar on IPCC Assessment Report [T-PHYS-107692]

**Responsible:** Prof. Dr. Joaquim José Ginete Werner Pinto  
Prof. Dr. Corinna Hoose  
Patrick Ludwig

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-100951 - Components of the Climate System](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Irregular	1

Events					
WT 21/22	4052194	<a href="#">Seminar on IPCC Assessment Report</a>	2 SWS	Advanced seminar ( / ●)	Ginete Werner Pinto, Ludwig
Exams					
WT 21/22	7800084	<a href="#">Seminar on IPCC Assessment Report</a>			Fink

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

### Competence Certificate

Study of a chapter of the current IPCC report with subsequent presentation (~ 20-25 min) and submission of a written summary (1 page).

Below you will find excerpts from events related to this course:

V

### Seminar on IPCC Assessment Report

4052194, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

Advanced seminar (HS)  
On-Site

### Content

Causes of climate change and paleoclimate (external and internal influence factors on the climate, results and structure of simple climate models with and without feedbacks, radiation effect and importance of greenhouse gases, results of model projections of the global climate, IPCC process structure and importance for the life on earth).

The objectives of this Seminar are to provide an overview of the last IPCC Report (currently 2013) and to develop scientific presentation and discussion skills.

### Organizational issues

Please sign up for more information in the Ilias course.

T

**7.56 Course: Seminar on Recent Topics of Risk Science [T-PHYS-107673]****Responsible:** Dr. Ellen Gottschämmer**Organisation:** KIT Department of Physics**Part of:** [M-PHYS-103336 - Geophysical analysis of natural hazards](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	1

Exams			
WT 21/22	7800109	<a href="#">Seminar on recent questions about risk science</a>	Gottschämmer

**Modeled Conditions**

The following conditions have to be fulfilled:

1. The course [T-PHYS-105113 - Geophysical Risk Seminar](#) must not have been started.

T

**7.57 Course: Tropical Meteorology [T-PHYS-107693]**

**Responsible:** Prof. Dr. Peter Knippertz  
**Organisation:** KIT Department of Physics  
**Part of:** [M-PHYS-100951 - Components of the Climate System](#)

**Type**  
Completed coursework

**Credits**  
0

**Grading scale**  
pass/fail

**Recurrence**  
Irregular

**Version**  
3

Events					
WT 21/22	4052111	<a href="#">Tropical Meteorology</a>	2 SWS	Lecture / 🗎	Knippertz
WT 21/22	4052112	<a href="#">Exercises to Tropical Meteorology</a>	1 SWS	Practice / 🗎	Knippertz, Lemburg
Exams					
WT 21/22	7800085	<a href="#">Tropical Meteorology (Prerequisite)</a>			Fink

Legend: 🗎 Online, 🔄 Blended (On-Site/Online), 🗎 On-Site, ✕ Cancelled

**Competence Certificate**

Students must achieve 50% of the points on the exercise sheets.

Below you will find excerpts from events related to this course:

V

**Tropical Meteorology**

4052111, WS 21/22, 2 SWS, Language: English, [Open in study portal](#)

**Lecture (V)**  
**On-Site**

**Content**

Dynamics and climate of the Tropics (tropical circulation, Hadley and Walker cells, monsoons, El Niño, equatorial waves, Madden-Julian Oscillation, easterly waves, tropical cyclones, tropical squall lines).

**Organizational issues**

Please sign up for more information in the Ilias course.

## T

## 7.58 Course: Turbulent Diffusion [T-PHYS-108610]

**Responsible:** Prof. Dr. Corinna Hoose  
Dr. Gholamali Hoshyaripour

**Organisation:** KIT Department of Physics

**Part of:** [M-PHYS-100954 - Applied Meteorology](#)

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each summer term	5

Events					
ST 2021	4052081	<a href="#">Turbulent Diffusion</a>	2 SWS	Lecture /	Hoshyaripour, Hoose
ST 2021	4052082	<a href="#">Exercises to Turbulent Diffusion</a>	1 SWS	Practice /	Hoshyaripour, Hoose, Bruckert
Exams					
ST 2021	7800019	<a href="#">Turbulent Diffusion (Prerequisite)</a>	Ginete Werner Pinto		

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

**Competence Certificate**

There are 7 exercises with 100 points in total.

To be admitted for the oral exam the students must:

- Obtain at least 50 points from exercises.
- Present and explain at least one of the ICON-ART exercises in the class.

**Prerequisites**

noone

Below you will find excerpts from events related to this course:

## V

**Turbulent Diffusion**

4052081, SS 2021, 2 SWS, Language: English, [Open in study portal](#)

Lecture (V)  
Online

**Content**

1. Life cycle of air pollutants
2. Relevant processes and substances
3. Quantification of trace substances
4. Emissions
5. Turbulence and averaging
6. The diffusion equation
7. Chemical Transformations
8. Aerosol processes
9. Atmospheric models: ICON-ART modeling system
10. Parametrisation of turbulent fluxes
11. Aerosol interactions

**Organizational issues**

- First meeting: 12.4. at 14:00 on MSTeams. Please install the MS-Teams app before the start of the first lecture. Use your KIT account for MS-Teams. If you have problems with installation etc. please contact [ali.hoshyaripour@kit.edu](mailto:ali.hoshyaripour@kit.edu)
- Please register for the ILIAS course to receive further information

## V

**Exercises to Turbulent Diffusion**

4052082, SS 2021, 1 SWS, Language: English, [Open in study portal](#)

Practice (Ü)  
Online

**Content**

There are 7 exercises with 100 points in total. To be admitted for the oral exam the students must:

- Obtain at least 50 points from exercises.
- Present and explain at least one of the ICON-ART exercises in the class.

**Organizational issues**


- Please register for the ILIAS course to receive further information







## T 7.59 Course: Visualization [T-INFO-101275]

**Responsible:** Prof. Dr.-Ing. Carsten Dachsbacher  
**Organisation:** KIT Department of Informatics  
**Part of:** [M-INFO-102980 - Informatics for Meteorology Students](#)

Type	Credits	Grading scale	Recurrence	Version
Oral examination	5	Grade to a third	Each summer term	1

Events					
ST 2021	2400175	<a href="#">Visualisierung</a>	2 SWS	Lecture / 	Dachsbacher, Piochowiak
WT 21/22	24183	<a href="#">Visualisation</a>	2 SWS	Lecture	Dachsbacher
Exams					
ST 2021	7500193	<a href="#">Visualization</a>			Dachsbacher
WT 21/22	7500563	<a href="#">Visualization</a>			Dachsbacher

Legend:  Online,  Blended (On-Site/Online),  On-Site,  Cancelled

T

**7.60 Course: Wildcard [T-PHYS-108283]****Organisation:** University**Part of:** [M-BGU-102759 - Computer Vision and Remote Sensing](#)

Type	Credits	Grading scale	Version
Examination of another type	4	Grade to a third	1

T

**7.61 Course: Wildcard [T-PHYS-106796]****Organisation:** University**Part of:** [M-PHYS-103403 - Module Wildcard Electives](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each term	1

T

**7.62 Course: Wildcard [T-PHYS-106794]****Organisation:** University**Part of:** [M-PHYS-103403 - Module Wildcard Electives](#)

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

T

**7.63 Course: Wildcard [T-PHYS-104677]****Organisation:** KIT Department of Physics**Part of:** [M-PHYS-102352 - Interdisciplinary Qualifications](#)

Type	Credits	Grading scale	Version
Completed coursework	2	pass/fail	1

T

**7.64 Course: Wildcard [T-PHYS-106797]****Organisation:** University**Part of:** [M-PHYS-103403 - Module Wildcard Electives](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	5	Grade to a third	Each term	1

T

**7.65 Course: Wildcard [T-PHYS-106795]****Organisation:** University**Part of:** [M-PHYS-103403 - Module Wildcard Electives](#)

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

T

**7.66 Course: Wildcard [T-PHYS-108285]****Organisation:** University**Part of:** [M-BGU-102759 - Computer Vision and Remote Sensing](#)

Type	Credits	Grading scale	Version
Completed coursework	4	pass/fail	1



T

**7.67 Course: Wildcard [T-PHYS-108284]****Organisation:** University**Part of:** [M-BGU-102759 - Computer Vision and Remote Sensing](#)

Type	Credits	Grading scale	Version
Examination of another type	4	Grade to a third	1

T

**7.68 Course: Wildcard [T-PHYS-104675]****Organisation:** KIT Department of Physics**Part of:** [M-PHYS-102352 - Interdisciplinary Qualifications](#)

Type	Credits	Grading scale	Version
Examination of another type	2	Grade to a third	1

T

**7.69 Course: Wildcard [T-PHYS-108286]****Organisation:** University**Part of:** [M-BGU-102759 - Computer Vision and Remote Sensing](#)

Type	Credits	Grading scale	Version
Completed coursework	4	pass/fail	1

## Guidelines to Master's Thesis

In the following, the most important steps and necessary formalities related to the compilation and submission of the Master's thesis are described. The description comprises the closely interlinked modules "Specialization Phase" and "Master's Thesis", thus two semesters or a 12-month period. It is a guideline, not a legally binding regulation document. Questions can be directed to Andreas Fink ([andreas.fink@kit.edu](mailto:andreas.fink@kit.edu)) or Kathi Maurer ([kathi.maurer@kit.edu](mailto:kathi.maurer@kit.edu)).

### 1. Finding a topic and supervisor

The "standard" case is that you will obtain a topic and supervisor from the list at our homepage. Please approach the respective supervisor(s) for more details in case you are interested. Please note that it is possible to choose topics that were not listed under the above-mentioned URL. In this case, approach professors, "Privatdozenten", and group leaders directly.

In this context, it shall be noted that the Institute of Meteorology and Climate Research (IMK) has three departments: **TRO** focuses on the troposphere, **AAF** on aerosols, **ASF** on atmospheric trace gases and remote sensing. Master theses can be written in all three departments.

### 2. Registration and Deadlines

Before the start of the module *Specialization Phase*, students need to personally visit the Examination Office of the KIT Faculty of Physics:

*Prüfungssekretariat, Ms. Anja Müller*

*Physics Building 30.21, 9th floor, Room 9-13;*

*E-mail: [pruefungssekretariat@physik.kit.edu](mailto:pruefungssekretariat@physik.kit.edu)*

*Phone 0721 608-43438*

If all requirements are met, a signed and stamped form will be issued.

Students use this form to contact their Advisor to discuss and fill in, amongst others, the fields "Advisor/ Co-Advisor", "Preliminary title of thesis", and "Start of the thesis".

The Advisor signs the form and sends it back to the Examination Office.

The Examination Office will register the thesis in the Campus Management System with the preliminary working title, the advisors and the start date. The deadline for submission of the thesis is calculated by the system and monitored by the Examination Office (12 months after starting date). These information are visible for the student in the Campus student portal.

The following points are worthy of note:

- The application for the Master's thesis will be accepted by Ms. Müller, if all four meteorology modules of the 1st and 2nd MSc semester are entered in the Campus Management System. The modules *Soft Skills* and *Complementary Elective* may still be incomplete and should be completed in the course of the *Specialization Phase*.
- If the oral module exam has already been passed in one or more of the meteorological modules but has not yet been entered, an e-mail from the Responsible Lecturer to Ms. Müller, confirming the successful completion of the module, is sufficient.
- Important: If one of the four Master modules has not been passed because course components ("Teilleistungen") have not yet been completed and therefore the prerequisites for the oral examination have not yet been met, please speak to the study advisor Prof. Dr. Andreas H. Fink, to prevent an unnecessary delay of the study by one semester.
- Deadline extensions are handled very restrictively and are only possible in justified individual cases.

### 3. The module *Specialization Phase*

Formally, the first six months of final thesis work belong to the module *Specialization Phase*. In these six months, a seminar will be given in the *Seminar on the Specialization Phase* (“Studierendenseminar”) in the context of the *Scientific Concept Development*. It should be noted that this seminar must be given in the “Studierendenseminar” that usually takes place during the lecture period on Wednesdays from 15:45-17:15 o'clock. Suggestions for dates and seminar titles should be sent to [Kathi Maurer](#), ideally before the semester starts. The current [seminar-calendar](#) can be found on the website.

Important: Please register in the Campus Management System before the seminar on the *Specialization Phase*. Formally, this is possible when 3 of the 4 master modules in meteorology in the Campus Management System have been passed.

The seminar talk should take 20-25 minutes, followed by a discussion. The total duration should not exceed 45 minutes. After the seminar, there should be a feedback discussion with the Advisors and the Supervisor, in which the progress made so far is evaluated and next steps are discussed.

Advisors or Supervisors sign a form, which documents the presentation of the lecture with date and title.

Please forward the signed form to Mrs. Stenschke or Prof. Knippertz, who will enter the *Specialization Phase* in the Campus Management System.

### 4. The module *Master's Thesis*

Within the 12-month period, the Master's thesis is to be submitted to Ms. Müller as a written scientific paper.

Five bound copies must be made, with three copies being submitted to Ms. Müller, all three signed by the first Examiner with a text like for example:

**„Accepted as an examination copy.“**

Please note: With this signature the first examiner declares that the work is graded at least with a mark of 4.0! If doubts as to the latter grading exists, the examiner will write on all three copies a text like:

**„Inspection copy.“**

Ms. Müller confirms the receipt of the copies, which are then submitted to the first and second Examiners and on the basis of which the reports are prepared. This delivery is relevant for the 12-month deadline.

Please give the fourth and fifth bound copy to Frau Schönbein for the library at Campus South and the DWD library. Please send a PDF of the submitted work to [Mr. Brückel](#), the IT administrator at

Campus South. This PDF file is available for free download on the *IMK* website pending on the consent of the Advisor.

After submission, a 20-25 minute seminar must be held in the respective seminars of the department TRO, ASF, or AAF (cf. Section 4.1), where the thesis was written. This seminar can be held after the 12-month period and should take place at one of the next possible dates. Note: This final seminar can only take place during the lecture period.

After the seminar, a [form](#) must be completed, signed by the Advisor and the Co-Advisor or Supervisor and sent to Ms. Stenschke. The reports will be prepared by the Advisors only after the final presentation, as this is part of the assessment and is included in the evaluation.

#### 4. Glossary

- **Advisor (“Berichterstatter or” Gutachter”):** This is usually a professor or a “Privatdozent” who acts as the first examiner.
- **Co-Advisor (“Zweitgutachter”):** This is usually a professor or a “Privatdozent” who acts as the second examiner.
- **Supervisor (“Betreuer”):** He/she supervises the Master Student, is often the Advisor or Co-Advisor, but can also be research staff (see also “group leader”).
- **“Privatdozent”:** This is an habilitated staff member. He can act as an Advisor. However, the second examiner must be a full professor in this case. This is also true for so-called “apl. Professor”.
- **Group Leader (“Gruppenleiter”):** Group leaders in Campus North are senior scientists. They can act as Supervisors, but not as Advisors if they are not habilitated or are an “apl. Professor” (please see “Privatdozent”).
- **“Responsible Lecturer”:** This is the “Modulverantwortliche” who enters the final grade of his/her module into the Campus Management System.
- **“Examination Office” (“Prüfungssekretariat”):** This is the “Prüfungssekretariat” of the Faculty of Physics. The Examination Office is currently managed by Ms. Müller.
- **Campus Management System (CAS):** Amongst others, results of modules are entered in CAS.
- **“Course Component”:** This is the so-called “Teilleistung”, often a lecture.
- **“Seminar on the Specialization Phase”:** This is also referred to as “Studierendenseminar”, in which also BSc students give their talks. It is currently scheduled on Wednesdays 15:45-17:15 hours.