Karlsruher Institut für Technologie

Module Handbook
Meteorology and Climate Physics 2021 (M.Sc.)

SPO 2021

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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 Climate Physics, 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.

For more information please visit https://www.kit.edu/kit/english/corona-faq.php?tab=%5B30607%5D#tabpanel-30607

2 Qualification Goals

The graduates of the Master's program in Meteorology and Climate Physics 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 and Climate Physics compared to other universities lies in the broad range of aspects of Meteorology and Climate Physics covered as well as the strong research relevance. A successful completion of the Master's program in Meteorology and Climate Physics 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 Study Program Structure

Mandatory	
Master's Thesis	30 CP
Atmospheric and Climate Processes	24 CP
Applied and Experimental Meteorology	24 CP
Scientific Work	30 CP
Compulsory Electives	8 CP
Transferable Skills	4 CP
Voluntary	
Additional Examinations *This field will not influence the calculated grade of its parent.*	

3.1 Master's Thesis

Credits
30

Mandatory				
M-PHYS-105720	Master's Thesis	DE/EN	WS+SS	30 CP

3.2 Atmospheric and Climate Processes

Credits
24

Mandatory				
M-PHYS-105715	Components of the Climate System	EN	WS	12 CP
M-PHYS-105716	Atmospheric Processes	EN	WS	12 CP

3.3 Applied and Experimental Meteorology

Credits
24

Mandatory				
M-PHYS-105717	Experimental Meteorology	EN	SS	10 CP
M-PHYS-105718	Applied Meteorology	EN	SS	14 CP

3.4 Scientific Work

Credits
30

Mandatory				
M-PHYS-105719	Specialization Phase	DE/EN	WS+SS	30 CP

3.5 Compulsory Electives

Credits
8

Compulsory Elective Modules (Election: at least 8 credits)				
M-PHYS-101664	Modern Theoretical Physics for Teaching Degree Students	DE	WS	8 CP
M-BGU-102757	Computer Vision and GIS	DE/EN	WS	9 CP
M-BGU-102758	GIS and Remote Sensing	DE	WS	9 CP
M-BGU-102759	Computer Vision and Remote Sensing	DE/EN	SS	7 CP
M-BGU-102760	GIS and Geo Data Infrastructures	DE	WS	10 CP
M-INFO-102980	Informatics for Meteorology Students	DE	Jährlich	8 CP
M-PHYS-103403	Module Wildcard Electives	DE	WS+SS	8 CP
M-BGU-103398	Geoecology	DE	WS	8 CP
M-BGU-103422	Basics of Estimation Theory and its Application in Geoscience Remote Sensing	DE/EN	SS	7 CP
M-PHYS-101833	Geological Hazards and Risk	EN	WS	8 CP
M-BGU-105095	Satellite Climatology: Remote Sensing of a Changing Climate	EN	SS	4 CP
M-BGU-105504	Fluid Mechanics and Turbulence *First usage possible from Oct 01, 2020.*	EN	SS	9 CP
M-MATH-105831	Numerical Methods *First usage possible from Oct 01, 2021.*	EN	SS	5 CP
M-PHYS-106333	Modern Theoretical Physics I, Foundations of Quantum Mechanics *First usage possible from Apr 01, 2023.*	DE	SS	8 CP
M-INFO-105630	Machine Learning for Natural Sciences with Exercises *First usage possible from Jul 31, 2023.*	EN	SS	6 CP
M-INFO-106470	Machine Learning in Climate and Environmental Sciences *First usage possible from Nov 10, 2023.*	EN	WS	6 CP
M-PHYS-106532	Introduction to General Relativity *First usage possible from Sep 16, 2024.*	EN	WS	8 CP

3.6 Transferable Skills

Credits
4

Mandatory				
M-PHYS-105877	Interdisciplinary Qualifications *First usage possible from Nov 12, 2021.*	DE/EN	WS+SS	4 CP

3.7 Additional Examinations

Additional Examinations (Election: at most 30 credits)				
M-FORUM-106753	Supplementary Studies on Science, Technology and Society *First usage possible from Oct 01, 2024.*	DE	WS+SS	16 CP
M-INFO-106470	Machine Learning in Climate and Environmental Sciences *First usage possible from Dec 20, 2024.*	EN	WS	6 CP

4 Program

The master's degree program in Meteorology and Climate Physics 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 and Climate Physics (SPO 2021)

Semester	Credit-points	Atmosphere and Climate Processes	Applied and Experimental Meteorology	Electives	Scientific Work	Master's Thesis
1 (WS)	**30** 3 Examinations	**Components of the Climate System** 12 ECTS **Atmopsheric Processes** 12 ECTS		**Elective 1 &** **Elective 2** at least 8 ECTS		
2 (SS)	**31** 3 Examinations		**Experimental Meteorology** 10 ECTS **Applied Meteorology** 14 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 and Climate Physics. 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 2021)

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 and Climate Physics 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 and Climate Physics 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 and Climate Physics 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 (Bundeselterngeld- 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) n 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 and Climate Physics. 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) he student shall submit the documents required for recognition. Students newly enrolled in the Master's Program in Meteorology and Climate Physics shall submit the application together with the documents required for recognition within one semester after enrolment. 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 program

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 recognized by the examination board. Students of **Meteorology and Climate Physics** fill in the form after consulting **appl. 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 on our website under “Stay abroad”. 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 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 (SPO §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 [M-PHYS-105718]

Coordinators: Prof. Dr. Joaquim José Ginete Werner Pinto
Organisation: KIT Department of Physics
Part of: Applied and Experimental Meteorology

Credits	Grading	Recurrence	Duration	Language	Level	Version
14 CP	graded	Each summer term	1 term	English	4	2

Mandatory			
T-PHYS-111430	Applied Meteorology (Module Exam)	4 CP	Ginete Werner Pinto
Compulsory Electives Applied Meteorology (Election: at least 10 credits)			
T-PHYS-111426	Methods of Data Analysis	3 CP	Ginete Werner Pinto, Knippertz
T-PHYS-111427	Turbulent Diffusion	3 CP	Hoose, Hoshyaripour
T-PHYS-111428	Energy Meteorology	1 CP	Emeis, Ginete Werner Pinto
T-PHYS-111429	Advanced Numerical Weather Prediction	3 CP	Knippertz
T-PHYS-114348	The Future of Weather and Climate Modeling (Literature Seminar)	1 CP	Hoose, Keshtgar, Knippertz, Maranan

Assessment
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 and Climate Physics

Competence Goal
The students can professionally explain essential aspects of applications 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.

The students are able to engage with scientific literature in the field of weather and climate modeling. They can explain the historical evolution of modeling approaches, current developments, and emerging technologies, including machine learning and high-resolution simulations. They have mastered academic skills, including the analysis of scientific texts, structured presentation of research findings, and participation in discussions. The students are aware of the principles of good scientific practice and apply them throughout their work.

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)
- The Literature seminar on **“The Future of Weather and Climate Modeling”** is a seminar-style course designed for Master's students, ideally in meteorology and climate physics. It provides a platform for students to engage with scientific literature, acquire soft skills in working with scientific publications, and explore trending topics in weather and climate science. The focus is on covering the historical evolution of models, current advances, and emerging technologies such as machine learning and high-resolution simulations.

Module Grade Calculation
Grade of the oral exam.

Workload
Presence time in lectures, exercises: 90 hours

Preparation / follow-up: 90 hours

Exam preparation: 120 hours

Recommendations
Basic knowledge in statistics are helpful.

M 6.2 Module: Atmospheric Processes [M-PHYS-105716]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
12 CP	graded	Each winter term	1 term	English	4	2

Mandatory			
T-PHYS-111420	Atmospheric Processes (Module Exam)	4 CP	Hoose
Compulsory Electives Atmospheric Processes (Election: at least 8 credits)			
T-PHYS-111416	Cloud Physics	3 CP	Hoose
T-PHYS-111417	Energetics	1 CP	Fink
T-PHYS-111418	Atmospheric Aerosols	3 CP	Möhler
T-PHYS-111419	Atmospheric Radiation	1 CP	Höpfner

Assessment
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 Atmosperic 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.

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)

Module Grade Calculation
Grade of the oral exam

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 [M-BGU-103422]

Coordinators: Prof. Dr. Jan Cermak
Prof. Dr.-Ing. Stefan Hinz
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Compulsory Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
7 CP	graded	Each summer term	1 term	German/English	4	2

Mandatory			
T-BGU-106821	Basics of Estimation Theory, Prerequisite *This item will not influence the grade calculation of this parent.*	1 CP	Hinz
T-BGU-106633	Data Analysis in Geoscience Remote Sensing Projects, Prerequisite *This item will not influence the grade calculation of this parent.*	2 CP	Andersen, Cermak
T-BGU-106822	Basics of Estimation Theory and its Application in Geoscience Remote Sensing	4 CP	Cermak, Hinz

Assessment
oral exam of about 30 min.

Prerequisites
none

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.

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.

Module Grade Calculation
grade of oral exam

Workload
210 h total, thereof 45 h contact hours

M 6.4 Module: Components of the Climate System [M-PHYS-105715]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
12 CP	graded	Each winter term	1 term	English	4	2

Mandatory			
T-PHYS-111415	Components of the Climate System (Module Exam)	4 CP	Fink
Compulsory Electives Components of the Climate System (Election: at least 8 credits)			
T-PHYS-111410	Seminar on IPCC Assessment Report	1 CP	Ginete Werner Pinto
T-PHYS-111411	Tropical Meteorology	3 CP	Knippertz
T-PHYS-111412	Climate Modeling & Dynamics with ICON	3 CP	Ginete Werner Pinto
T-PHYS-111413	Middle Atmosphere in the Climate System	1 CP	Höpfner, Sinnhuber
T-PHYS-111414	Ocean-Atmosphere Interactions	1 CP	Fink
T-PHYS-111273	Arctic Climate System	1 CP	Sinnhuber

Assessment
Prerequisite: Coursework (“Studienleistung”)

For type of Coursework see Course description (“Teilleistungsbeschreibung”)

→ successful completion of the prerequisites entitles to exam

Examination: Assessment (“Prüfungsleistung”)

T-PHYS-111415 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.

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.

Module Grade Calculation
Grade of the oral exam.

Workload
Presence time in lectures, exercises: 120 hours

Preparation / follow-up: 120 hours

Exam preparation: 120 hours

Recommendations
Basic knowledge about the climate system is helpful.

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

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
9 CP	graded	Each winter term	1 term	German/English	4	2

Mandatory			
T-BGU-101681	Introduction to GIS for Students of Natural, Engineering and Geo Sciences	3 CP	Wursthorn
T-BGU-103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite	3 CP	Wursthorn
T-BGU-101732	Image Processing and Computer Vision	3 CP	Weidner

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

Prerequisites
None

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.

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.

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

Recommendations
None

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

Coordinators: Prof. Dr. Jan Cermak
Dr.-Ing. Uwe Weidner
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Compulsory Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
7 CP	graded	Each summer term	2 terms	German/English	4	3

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

Assessment
oral exams

Prerequisites
none

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.

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 mechnisms 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.

Module Grade Calculation
weighted mean by credit points

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 [M-PHYS-105717]

Coordinators: Prof. Dr. Björn-Martin Sinnhuber
Organisation: KIT Department of Physics
Part of: Applied and Experimental Meteorology

Credits	Grading	Recurrence	Duration	Language	Level	Version
10 CP	graded	Each summer term	1 term	English	4	3

Mandatory			
T-PHYS-111425	Experimental Meteorology (Module Exam)	2 CP	Sinnhuber
Compulsory Electives Experimental Meteorology (Election: at least 8 credits)			
T-PHYS-111421	Advanced Practical Course	2,5 CP	Höpfner
T-PHYS-111422	Field Trip	1,5 CP	Ginete Werner Pinto
T-PHYS-111424	Remote Sensing of Atmosphere and Ocean	3 CP	Sinnhuber
T-BGU-111185	Atmospheric Remote Sensing Infrastructures, Prerequisite	1 CP	Cermak
T-PHYS-113508	Placeholder	6 CP	Studiendekan des KIT-Studienganges

Assessment
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.

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),
- **atmospheric remote sensing infrastructures** (Large-scale research infrastructures: role in environmental and atmospheric research, Overview of atmospheric remote sensing infrastructures at KIT, Details of selected atmospheric remote sensing infrastructures and ongoing project work
- 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.

Module Grade Calculation
Grade of the oral exam

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 [M-BGU-105504]

Coordinators: Prof. Dr. Olivier Eiff
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Compulsory Electives (Usage from 10/1/2020)

Credits	Grading	Recurrence	Duration	Language	Level	Version
9 CP	graded	Each summer term	2 terms	English	4	1

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

Electives 1 (Election: 1 item as well as 6 credits)			
T-BGU-106612	Advanced Fluid Mechanics	6 CP	Eiff
T-BGU-110841	Fluid Mechanics of Turbulent Flows	6 CP	Uhlmann
Electives 2 (Election: 1 item as well as 3 credits)			
T-BGU-110411	Flow Measurement Techniques	3 CP	Gromke
T-BGU-111060	Building and Environmental Aerodynamics	3 CP	Gromke

Assessment
- module component T-BGU-106612 with written examination according to § 4 Par. 2 No. 1
- module component T-BGU-110841 with oral examination according to § 4 Par. 2 No. 2
- module component T-BGU-110411 with oral examination according to § 4 Par. 2 No. 2
- module component T-BGU-111060 with oral examination according to § 4 Par. 2 No. 1

details about the learning controls, see module components

Prerequisites
none

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.

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.

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.

Additional Information
none

Workload
contact hours (1 HpW = 1 h x 15 weeks):
depending on the selected courses or examinatrions, 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 examinatrions, 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 (selectable partial examination 1): 60 h
- preparation and follow-up lecture/exercises Fluid Mechanics of Turbulent Flows : 60 h
- examination preparation Advanced Fluid Mechanics (selectable partial examination 1): 60 h
- preparation and follow-up lecture/exercises Flow Measurement Techniques: 30 h
- examination preparation Flow Measurement Techniques (selectable partial examination 2): 30 h
- preparation and follow-up lecture/exercises Building and Environmental Aerodynamics: 30 h
- examination preparation Building and Environmental Aerodynamics (selectable partial examination 2): 30 h

total: 270 h

Recommendations
basics in Mathematics and Hydromechanics;
prior knowledge in programming with Matlab is helpful for the couorse "Fluid Mechanics of Turbulent Flows"

start of the module in summer term

Base For
non specified

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

Coordinators: Prof. Dr. Wolfgang Wilcke
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Compulsory Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each winter term	2 terms	German	3	2

Mandatory			
T-BGU-107487	Geomorphology and Soil Science	8 CP	Wilcke
T-BGU-107486	Field Course Soil Science	1 CP	Wilcke

Assessment
- 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

Prerequisites
None

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.

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-discplacements, glacial and periglacial dynamics, eolic, fluviatile 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 prperties 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.

Module Grade Calculation
Grade of the module is grade of the written examination

Additional Information
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

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

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

Coordinators: Dr. Andreas Schäfer
Organisation: KIT Department of Physics
Part of: Compulsory Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each winter term	1 term	English	4	5

Mandatory			
T-PHYS-103525	Geological Hazards and Risk	8 CP	Schäfer

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

Prerequisites
none

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. The have fundamental knowledge of risk reduction and risk management. They know methods of risk modelling and are able to apply them.

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

Module Grade Calculation
Project work will be graded.

Workload

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

Teaching and Learning Methods
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: GIS and Geo Data Infrastructures [M-BGU-102760]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
10 CP	graded	Each winter term	2 terms	German	4	2

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

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

Prerequisites
None

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.

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.

Module Grade Calculation
weighted mean

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 6.12 Module: GIS and Remote Sensing [M-BGU-102758]

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

Credits	Grading	Recurrence	Duration	Language	Level	Version
9 CP	graded	Each winter term	2 terms	German	4	2

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

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

Prerequisites
None

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.

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.

Module Grade Calculation
weighted mean

Additional Information
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

Recommendations
None

M 6.13 Module: Informatics for Meteorology Students [M-INFO-102980]

Coordinators: Prof. Dr. Bernhard Beckert
Organisation: KIT Department of Informatics
Part of: Compulsory Electives

Credits	Grading	Duration	Language	Level	Version
8 CP	graded	2 terms	German	4	3

Informatics for Meteorology Students (Election: at least 1 item as well as at least 8 credits)			
T-INFO-101345	Parallel Computer Systems and Parallel Programming	4 CP	Streit
T-INFO-101298	Distributed Computing	4 CP	Streit
T-INFO-102061	Mobile Computing and Internet of Things	2,5 CP	Beigl
T-INFO-101497	Database Systems	4 CP	Böhm
T-INFO-101275	Visualization	5 CP	Dachsbacher
T-INFO-111622	Data Science 1	5 CP	Böhm, Fouché

Assessment
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 Basiskenntnisse zu Personal Area Networks (PAN) bennenen, 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 analsieren 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 Benutzerschnittstellenentwurf 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 Ingenieurswissenschaften. 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• Perzeption 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

Additional Information

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

Workload

mind. 240 Stunden.

M 6.14 Module: Interdisciplinary Qualifications [M-PHYS-105877]

Coordinators: Prof. Dr. Corinna Hoose
Organisation: KIT Department of Physics
Part of: Transferable Skills (Usage from 11/12/2021)

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each term	2 terms	German/English	1	2

Electives (Election: at least 4 credits)			
T-PHYS-112131	Self Assignment MSc Meteorology and Climate Physics 1 CP (graded)	1 CP	
T-PHYS-112132	Self Assignment MSc Meteorology and Climate Physics 1 CP (graded)	1 CP	
T-PHYS-112133	Self Assignment MSc Meteorology and Climate Physics 1 CP (ungraded)	1 CP	
T-PHYS-112134	Self Assignment MSc Meteorology and Climate Physics 1 CP (ungraded)	1 CP	
T-PHYS-111771	Self Assignment MSc Meteorology and Climate Physics (graded)	2 CP	
T-PHYS-111772	Self Assignment MSc Meteorology and Climate Physics (graded)	2 CP	
T-PHYS-111769	Self Assignment MSc Meteorology and Climate Physics (ungraded)	2 CP	
T-PHYS-111770	Self Assignment MSc Meteorology and Climate Physics (ungraded)	2 CP	
T-PHYS-112135	Self Assignment MSc Meteorology and Climate Physics 3 CP (graded)	3 CP	
T-PHYS-112136	Self Assignment MSc Meteorology and Climate Physics 3 CP (ungraded)	3 CP	
T-PHYS-112137	Self Assignment MSc Meteorology and Climate Physics 4 CP (graded)	4 CP	
T-PHYS-112138	Self Assignment MSc Meteorology and Climate Physics 4 CP (ungraded)	4 CP	

Additional Information
Interdisciplinary qualifications (ÜQ) that have been completed at the House of Competence (HoC), Center for Applied Cultural Studies (ZAK) or the Language Center (SpZ) can be assigned in Self-Service.

To do this, first select a Self-Assignement achievement in your (LPs will be overwritten with the actually completed LPs) and then assign an ÜQ achievement via the tab "ÜQ-Leistungen".

M 6.15 Module: Introduction to General Relativity [M-PHYS-106532]

Coordinators: Prof. Dr. Thomas Schwetz-Mangold
Organisation: KIT Department of Physics
Part of: Compulsory Electives (Usage from 9/16/2024)

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each winter term	1 term	English	4	2

Mandatory			
T-PHYS-113186	Introduction to General Relativity	8 CP	Schwetz-Mangold

Assessment
Oral Exam. In the MSc Physics, this module is examined together with further modules attended as part of the major in physics. The total duration of the oral exam is approx. 60 minutes.

Prerequisites
none

Competence Goal
Students know and understand the central concepts of Special Relativity, such as index notation and Lorentz tensors and are familiar with the main concepts and techniques of General Relativity. Students know about black holes, gravitational waves and simple cosmological models. Participants of the course can apply the concepts and techniques they have learned to solve selected problems in General Relativity.

Content
This lecture gives an introduction to general relativity, the theory of space time and gravity. After a brief review of special relativity, the necessary tools to describe curved space time are introduced, as well as concepts such as the equivalence principle and geodesic motion. The Einstein equations are discussed, which relate the geometry of space time to the matter and energy content of it. In the second part of the lecture some important application of the general relativity are discussed, including black holes, gravitational waves and the basics of cosmology.

Workload
240 hours consisting of attendance time (60 hours), wrap-up of the lecture incl. exam preparation and preparation of the exercises (180 hours).

Recommendations
Basic knowledge on Special Relativity

Literature

- S. Carrol, Spacetime and Geometry - An Introduction to General Relativity, Cambridge Univ. Press 2019;
- S. Weinberg, Gravitation and Cosmology, Wiley, 1972;

more literature will be provided during the lecture

M 6.16 Module: Machine Learning for Natural Sciences with Exercises [M-INFO-105630]

Coordinators: Prof. Dr. Pascal Friederich
Organisation: KIT Department of Informatics
Part of: Compulsory Electives (Usage from 7/31/2023)

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each summer term	1 term	English	4	4

Mandatory			
T-INFO-110822	Machine Learning for Natural Sciences	3 CP	Friederich
T-INFO-111259	Machine Learning for Natural Sciences - Pass	3 CP	Friederich

Assessment
See partial achivements (Teilleistung)

Prerequisites
See partial achivements (Teilleistung)

Competence Goal
Qualification Objectives
• Students are able to name relevant machine learning methods, describe them, as well as develop independent proposals on how questions in the natural sciences and material sciences can be answered using machine learning methods.
Learning Objectives
• Necessary knowledge for the selection and, if necessary, the adaptation of suitable machine learning models.
• Knowledge about data availability and, if necessary, planning of training data generation
• Knowledge of practical implementation, training, and systematic evaluation of machine learning models in python using common libraries (sklearn, TensorFlow, Keras, PyTorch, etc.)
• Knowledge of ways and means to systematically analyze and interpret results.

Content
This module covers the theoretical and practical aspects of machine learning methods and their application to problems in natural sciences, especially in materials science and chemistry. Students gain insight into machine learning fundamentals as well as current research topics of this still young interdisciplinary field. Topics covered include the application of machine learning methods for medical image analysis, sequence analysis and generation, the prediction of material and molecular properties, generative models for materials design, Bayesian methods for decision making in autonomous experiments, as well as interpretation possibilities of all methods for gaining scientific understanding.
A practical exercise based on jupyter notebooks gives students insight into the practical aspects of machine learning for natural sciences and supports the learning process.

Workload
4 SWS: (2 SWS Lecture + 2 SWS Exercise + 1,5 x 4 SWS Preparation) x 15 + 30 h exam preparation
= 180 h

Recommendations
• Knowledge of the basics of machine learning is helpful but not required
• Interest in natural science topics is required
• Basic knowledge of python is recommended. It has to be acquired during the semester through self-study

M 6.17 Module: Machine Learning in Climate and Environmental Sciences [M-INFO-106470]

Coordinators: TT-Prof. Dr. Peer Nowack
Organisation: KIT Department of Informatics
Part of: Compulsory Electives (Usage from 11/10/2023)
Additional Examinations (Usage from 12/20/2024)

Credits	Grading	Recurrence	Duration	Language	Level	Version
6 CP	graded	Each winter term	1 term	English	4	1

Mandatory			
T-INFO-113083	Machine Learning in Climate and Environmental Sciences	6 CP	Nowack
T-INFO-113085	Machine Learning in Climate and Environmental Sciences - Pass	0 CP	Nowack

Assessment
See partial achievements (Teilleistung)

Prerequisites
See partial achievements (Teilleistung)

Competence Goal
Learning objectives:

Students will be able to effectively address complex data science challenges. They can design and use robust strategies/ modelling pipelines for machine learning applications in the climate and environmental sciences, which are transferable to other disciplines.
Their acquired knowledge will include major classes of machine learning techniques, how to choose and differentiate among algorithms in a variety of problem settings, ways of assessing important data properties that could for example help or interfere with modelling goals, and methods to combine data-driven modelling with prior scientific system understanding to increase performance and trustworthiness of machine learning.

Students will learn how to implement these approaches in Python, using major machine learning software packages.

Content
This module covers key concepts for real-world applications of machine learning, focusing on environmental data science. These include:

• foundations of machine learning (e.g., curse of dimensionality, cross-validation, cost functions, feature engineering)
• several widely applied regression, classification, and unsupervised learning algorithms (e.g., LASSO, random forests, Gaussian processes, neural networks, LSTMs, transformers, self-organizing maps)
• time series forecasting and causal inference.
• explainable AI (e.g., SHAP value analyses, feature permutation methods, intrinsically interpretable methods).

These concepts will be discussed in applied contexts, using current research examples from the climate and environmental sciences, including: climate change modelling, machine learning emulation of numerical models, forecasting air pollution and wildfires, understanding coupled dynamical systems such as global teleconnections in climate science, challenges in modelling non-stationary systems (e.g., predicting extreme weather events under global warming), and anomaly detection in measurement data.

The lectures are accompanied by computer exercises in which students learn how to implement and modify machine learning modelling pipelines first-hand.

Workload
Concerning in-person events, this is a 4 SWS module: 2 SWS for lectures, 2 SWS for exercises

Overall:

(2 SWS lectures + 2 SWS exercises + 1.5 x 4 SWS preparation and homework) x 15 +30 h preparation for the exam = 180 h = 6 ECTS

Recommendations
• Previous programming experience, e.g. in scientific contexts or in computer science, is required.
• Knowledge of fundamentals about machine learning is an advantage.
• Knowledge of the Python programming language is an advantage.
• Good knowledge of mathematical concepts such as linear algebra is an advantage.
• An interest in scientific questions important for the climate- and environmental sciences.

M 6.18 Module: Master's Thesis [M-PHYS-105720]

Coordinators: Prof. Dr. Corinna Hoose
Organisation: KIT Department of Physics
Part of: Master's Thesis

Credits	Grading	Recurrence	Duration	Language	Level	Version
30 CP	graded	Each term	1 term	German/English	4	1

Mandatory			
T-PHYS-109616	Master's Thesis	30 CP	Hoose

Assessment
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.

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 Prerequisites
The following conditions have to be fulfilled:

1. You need to have earned at least 40 credits in the following fields:
   - Applied and Experimental Meteorology
   - Atmospheric and Climate Processes
   - Compulsory Electives
   - Transferable Skills
2. The module M-PHYS-105719 - Specialization Phase must have been passed.

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.

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.

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

Additional Information
The maximum duration of the Master thesis is six months.

Further information on the procedure, implementation, and additional deadlines can be found on our website https://www.imk-tro.kit.edu/7730.php and in your applicable study and examination regulations.

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

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

M 6.19 Module: Modern Theoretical Physics for Teaching Degree Students [M-PHYS-101664]

Coordinators: Studiendekan Physik
Organisation: KIT Department of Physics
Part of: Compulsory Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each winter term	1 term	German	4	1

Mandatory			
T-PHYS-103203	Modern Theoretical Physics for Teaching Degree Students - Prerequisite	0 CP	Gieseke
T-PHYS-103204	Modern Theoretical Physics for Teaching Degree Students	8 CP	Gieseke

Assessment
See components of this module

Prerequisites
none

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.

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 excercises (150)

M 6.20 Module: Modern Theoretical Physics I, Foundations of Quantum Mechanics [M-PHYS-106333]

Coordinators: Studiendekan Physik
Organisation: KIT Department of Physics
Part of: Compulsory Electives (Usage from 4/1/2023)

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each summer term	1 term	German	4	1

Mandatory			
T-PHYS-112728	Modern Theoretical Physics I, Foundations of Quantum Mechanics, Prerequisite 1	5 CP	Metelmann
T-PHYS-112848	Modern Theoretical Physics I, Foundations of Quantum Mechanics	3 CP	Studiendekan Physik

Assessment
See components of this module

Prerequisites
none

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.

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 limit.
- 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
- Rotational symmetry and spin, degeneracy, irreducible representations of rotations: Addition of angular momenta, product representations of the angular group, Clebsch-Gordan coefficients, irreducible tensor operators, Wigner-Eckart theorem.
- Quantum Information
- Particles in the external electromagnetic field,
- Time-independent perturbation theory: non-degenerate and degenerate case, fine structure of hydrogen spectrum, Stark effect.

Workload
240 hours composed of active time (90), wrap-up of the lecture and preparation of the exercises and the exam (150)

Literature
Textbooks on Quantum Mechanics

M 6.21 Module: Module Wildcard Electives [M-PHYS-103403]

Organisation: University
Part of: Compulsory Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
8 CP	graded	Each term	1 term	German	4	1

Wildcard (Election: at least 1 item)			
T-PHYS-106794	Wildcard	2 CP	
T-PHYS-106795	Wildcard	3 CP	
T-PHYS-106796	Wildcard	4 CP	
T-PHYS-106797	Wildcard	5 CP	

Prerequisites
None

M 6.22 Module: Numerical Methods [M-MATH-105831]

Coordinators: Prof. Dr. Wolfgang Reichel
Organisation: KIT Department of Mathematics
Part of: Compulsory Electives (Usage from 10/1/2021)

Credits	Grading	Recurrence	Duration	Language	Level	Version
5 CP	graded	Each summer term	1 term	English	4	1

Mandatory			
T-MATH-111700	Numerical Methods - Exam	5 CP	Kunstmann, Liao, Reichel

Assessment
Success control takes the form of a written examination (120 minutes).

Prerequisites
none

Competence Goal
Students who pass the module are familiar with basic concepts and ways of thinking on the topic of numerical mathematics. They know different procedures for solving linear and nonlinear problems in numerical mathematics. They are furthermore able to use numerical methods for solving problems from applications in an independent, critical, and needs-based way.

Content
In the lecture basic ideas and numerical methods for the following topics will be presented:

- systems of linear equations, Gauss-algorithm, LR-decomposition, Cholesky decomposition
- eigenvalue problems, von-Mises iteration
- linear optimization (also called linear programming)
- error analysis
- Newton's method
- quadrature, Newton-Cotes formulas
- numerical solution of initial value problems, Runge-Kutta methods
- finite difference method for solving boundary value problems
- finite elements

Module Grade Calculation
The module grade is the grade of the written exam.

Workload
Approximately 150h workload. The workload includes:

45h - attendance in lectures, exercises and examination

105h – self studies:

- follow-up and deepening of the course content
- solving problem sheets
- literature study and internet research on the course content
- preparation for the module examination

M 6.23 Module: Satellite Climatology: Remote Sensing of a Changing Climate [M-BGU-105095]

Coordinators: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: Compulsory Electives

Credits	Grading	Recurrence	Duration	Language	Level	Version
4 CP	graded	Each summer term	1 term	English	4	3

Mandatory			
T-BGU-110305	Satellite Climatology: Remote Sensing of a Changing Climate, Examination	3 CP	Andersen, Cermak
T-BGU-110304	Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste	1 CP	Andersen, Cermak

Assessment

- 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".

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

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.

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

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

Additional Information
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 6.24 Module: Specialization Phase [M-PHYS-105719]

Coordinators: Prof. Dr. Corinna Hoose
Organisation: KIT Department of Physics
Part of: Scientific Work

Credits	Grading	Recurrence	Duration	Language	Level	Version
30 CP	pass/fail	Each term	1 term	German/English	4	1

Mandatory			
T-PHYS-111548	Scientific Concept Development	30 CP	Hoose

Assessment
Module examination: Coursework ("Studienleistung")

Coursework in accordance to §4(3) SPO Master's Meteorology and Climate Physics:

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.

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

Soft skills and compulsory elective can still be incomplete.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The field Atmospheric and Climate Processes must have been passed.
2. The field Applied and Experimental Meteorology must have been passed.

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.

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.

Additional Information
It should be noted that this seminar must be given in the "Studierendenseminar" that usually takes place during the lecture period on Thursdays from 15:45-17:15 o'clock. After booking a date in the respective Ilias course dates and seminar titles should be sent to Behrooz Keshtgar. Please follow further instructions in Ilias.

Workload
Independent scientific work: 820 hours
Preparation Lecture and presence in the accompanying seminar: 80 hours

M 6.25 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

Coordinators: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: Additional Examinations (Usage from 10/1/2024)

Credits	Grading	Recurrence	Duration	Language	Level	Version
16 CP	graded	Each term	3 terms	German	3	1

Election Notes
Students have to self-record the achievements obtained in the Supplementary Studies on Science, Technology and Society in their study plan. FORUM (formerly ZAK) records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the FORUM homepage at https://www.forum.kit.edu/english/. The title of the examination and the amount of credits override the modules placeholders.

If you want to use FORUM achievements for both your Interdisciplinary Qualifications and for the Supplementary Studies, please record them in the Interdisciplinary Qualifications first. You can then get in contact with the FORUM study services (stg@forum.kit.edu) to also record them in your Supplementary Studies.

In the Advanced Unit you can choose examinations from three subject areas: "About Knowledge and Science", "Science in Society" and "Science in Social Debates". It is advised to complete courses from each of the three subject areas in the Advanced Unit.

To self-record achievements in the Advanced Unit, you have to select a free placeholder partial examination first. The placeholders' title do *not* affect which achievements the placeholder can be used for!

Mandatory			
T-FORUM-113578	Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration	2 CP	Mielke, Myglas
T-FORUM-113579	Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration	2 CP	Mielke, Myglas
Advanced Unit Supplementary Studies on Science, Technology and Society (Election: at least 12 credits)			
T-FORUM-113580	Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration	3 CP	Mielke, Myglas
T-FORUM-113581	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration	3 CP	Mielke, Myglas
T-FORUM-113582	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration	3 CP	Mielke, Myglas
Mandatory			
T-FORUM-113587	Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society	0 CP	Mielke, Myglas

Assessment
The monitoring is explained in the respective partial achievement.

They are composed of:
- Protocols
- Reflection reports
- Presentations
- Preparation of a project work
- An individual term paper
- An oral examination
- A written exam

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by the FORUM.

Prerequisites
The course is offered during the course of study and does not have to be completed within a defined period. Enrollment is required for all assessments of the modules in the supplementary studies.
Participation in the supplementary studies is regulated by § 3 of the statutes. KIT students register for the supplementary studies by selecting this module in the student portal and booking a performance themselves. Registration for courses, assessments, and exams is regulated by § 8 of the statutes and is usually possible shortly before the start of the semester.
The course catalog, module description (module manual), statutes (study regulations), and guidelines for creating the various written performance requirements can be downloaded from the FORUM homepage at https://www.forum.kit.edu/begleitstudium-wtg.php.

Registration and exam modalities
PLEASE NOTE:
Registration on the FORUM, i.e. additionally via the module selection in the student portal, enables students to receive up-to-date information about courses or study modalities. In addition, registering on the FORUM ensures that you have proof of the credits you have earned. As it is currently (as of winter semester 24-25) not yet possible to continue additional credits acquired in the Bachelor's programme electronically in the Master's programme, we strongly advise you to digitally secure the credits you have earned by archiving the Bachelor's transcript of records yourself and by registering on FORUM.
In the event that a transcript of records of the Bachelor's certificate is no longer available - we can only assign the achievements of registered students and thus take them into account when issuing the certificate.

Competence Goal
Graduates of the Supplementary Studies on Science, Technology, and Society gain a solid foundation in understanding the interplay between science, the public, business, and politics. They develop practical skills essential for careers in media, political consulting, or research management. The program prepares them to foster innovation, influence social processes, and engage in dialogue with political and societal entities. Participants are introduced to interdisciplinary perspectives, encompassing social sciences and humanities, to enhance their understanding of science, technology, and society. The teaching objectives of this supplementary degree program include equipping participants with both subject-specific knowledge and insights from epistemological, economic, social, cultural, and psychological perspectives on scientific knowledge and its application in various sectors. Students are trained to critically assess and balance the implications of their actions at the intersection of science and society. This training prepares them for roles as students, researchers, future decision-makers, and active members of society.

Through the program, participants learn to contextualize in-depth content within broader frameworks, independently analyze and evaluate selected course materials, and communicate their findings effectively in both written and oral formats. Graduates are adept at analyzing social issues and problem areas, reflecting on them critically from a socially responsible and sustainable standpoint.

Content
The Supplementary Studies on Science, Technology and Society can be started in the 1st semester of the enrolled degree programme and is not limited in time. The wide range of courses offered by FORUM makes it possible to complete the program usually within three semesters. The supplementary studies comprises 16 or more credit points (LP). It consists of **two modules: the Basic Module (4 LP) and the Advanced Module (12 LP).**

The **basic Module** comprises the compulsory courses 'Lecture Series Supplementary Studies on Science, Technology and Society' and a basic seminar with a total of 4 LP.

The **Advanced Module** comprises courses totalling 12 LP in the humanities and social sciences subject areas 'On Knowledge and Science', 'Science in Society' and 'Science in Public Debates'. The allocation of courses to the accompanying study programme can be found on the homepage https://www.forum.kit.edu/wtg-aktuelland in the printed FORUM course catalogue.

The 3 thematic subject areas:

Subject area 1: About Knowledge and Science

This is about the internal perspective of science: students explore the creation of knowledge, distinguishing between scientific and non-scientific statements (e.g., beliefs, pseudo-scientific claims, ideological statements), and examining the prerequisites, goals, and methods of knowledge generation. They investigate how researchers address their own biases, analyze the structure of scientific explanatory and forecasting models in various disciplines, and learn about the mechanisms of scientific quality assurance.

After completing courses in the "Knowledge and Science" area, students can critically reflect on the ideals and realities of contemporary science. They will be able to address questions such as: How robust is scientific knowledge? What are the capabilities and limitations of predictive models? How effective is quality assurance in science, and how can it be improved? What types of questions can science answer, and what questions remain beyond its scope?

Subject area 2: Science in Society

This focuses on the interactions between science and different areas of society, such as how scientific knowledge influences social decision-making and how social demands impact scientific research. Students learn about the specific functional logics of various societal sectors and, based on this understanding, estimate where conflicts of goals and actions might arise in transfer processes—for example, between science and business, science and politics, or science and journalism. Typical questions in this subject area include: How and under what conditions does an innovation emerge from a scientific discovery? How does scientific policy advice work? How do business and politics influence science, and when is this problematic? According to which criteria do journalists incorporate scientific findings into media reporting? Where does hostility towards science originate, and how can social trust in science be strengthened?

After completing courses in the "Sciene in Society" area, students can understand and assess the goals and constraints of actors in different societal sectors. This equips them to adopt various perspectives of communication and action partners in transfer processes and to act competently at various social interfaces with research in their professional lives.

Subject area 3: Science in Public Debates

The courses in this subject area provide insights into current debates on major social issues such as sustainability, digitalization, artificial intelligence, gender equality, social justice, and educational opportunities. Public debates on complex challenges are often polarized, leading to oversimplifications, defamation, or ideological thinking. This can hinder effective social solution-finding processes and alienate people from the political process and from science. Debates about sustainable development are particularly affected, as they involve a wide range of scientific and technological knowledge in both problem diagnosis (e.g., loss of biodiversity, climate change, resource consumption) and solution development (e.g., nature conservation, CCS, circular economy).

By attending courses in "Science in Public Debates," students are trained in an application-oriented way to engage in factual debates—exchanging arguments, addressing their own prejudices, and handling contradictory information. They learn that factual debates can often be conducted more deeply and with more nuance than is often seen in public discourse. This training enables them to handle specific factual issues in their professional lives independently of their own biases and to be open to differentiated, fact-rich arguments.

Supplementary credits:
Additional LP (supplementary work) totalling a maximum of 12 LP can also be acquired from the complementary study programme (see statutes for the WTG complementary study programme § 7). § 4 and § 5 of the statutes remain unaffected by this. These supplementary credits are not included in the overall grade of the accompanying study programme. At the request of the participant, the supplementary work will be included in the certificate of the accompanying study programme and marked as such. Supplementary coursework is listed with the grades provided for in § 9.

Module Grade Calculation
The overall grade of the supplementary course is calculated as a credit-weighted average of the grades that were achieved in the advanced module.

Additional Information
Climate change, biodiversity crisis, antibiotic resistance, artificial intelligence, carbon capture and storage, and gene editing are just a few areas where science and technology can diagnose and address numerous social and global challenges. The extent to which scientific findings are considered in politics and society depends on various factors, such as public understanding and trust, perceived opportunities and risks, and ethical, social, or legal considerations.
To enable students to use their expertise as future decision-makers in solving social and global challenges, we aim to equip them with the skills to navigate the interfaces between science, business, and politics competently and reflectively. In the Supplementary Studies, they acquire foundational knowledge about the interactions between science, technology, and society.

They learn:
- How reliable scientific knowledge is produced,
- how social expectations and demands influence scientific research, and
- how scientific knowledge is adopted, discussed, and utilized by society.

The program integrates essential insights from psychology, philosophy, economics, social sciences, and cultural studies into these topics. After completing the supplementary studies programme, students can place the content of their specialized studies within a broader social context. This prepares them, as future decision-makers, to navigate competently and reflectively at the intersections between science and various sectors of society, such as politics, business, or journalism, and to contribute effectively to innovation processes, public debates, or political decision-making.

Workload
The workload is made up of the number of hours of the individual modules:

- Basic Module approx. 120 hours
- Advanced Module approx. 360 hours
> Total: approx. 480 hours

In the form of supplementary services, up to approximately 360 hours of work can be added.

Recommendations
It is recommended to complete the supplementary study program in three or more semesters, beginning with the lecture series on science, technology, and society in the summer semester. Alternatively, you can start with the basic seminar in the winter semester and then attend the lecture series in the summer semester.

Courses in the Advanced Module can be taken simultaneously. It is also advised to complete courses from each of the three subject areas in the advanced unit.

Teaching and Learning Methods
- Lectures
- Seminars/Project Seminars
- Workshops

7 Module components

T 7.1 Module component: Advanced Fluid Mechanics [T-BGU-106612]

Coordinators: 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	Term offered	Expansion	Version
Written examination	6 CP	graded	Each term	1 semesters	1

Courses					
ST 2025	6221701	Advanced Fluid Mechanics	4 SWS	Lecture / Practice (/ 🗣	Eiff
Exams					
ST 2025	8244106612	Advanced Fluid Mechanics			Eiff

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

Assessment
written exam, 90 min.

Prerequisites
none

Recommendations
none

Additional Information
none

Workload
180 hours

T 7.2 Module component: Advanced Numerical Weather Prediction [T-PHYS-111429]

Coordinators: Prof. Dr. Peter Knippertz
Organisation: KIT Department of Physics
Part of: M-PHYS-105718 - Applied Meteorology

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	3 CP	pass/fail	Each summer term	1 semesters	3

Courses					
ST 2025	4052051	Advanced Numerical Weather Prediction	2 SWS	Lecture / 🗣	Knippertz
ST 2025	4052052	Exercises to Advanced Numerical Weather Prediction	1 SWS	Practice / 🗣	Oertel, Knippertz
Exams					
ST 2025	7800017	Advanced Numerical Weather Prediction (Prerequisite)			Ginete Werner Pinto

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Advanced Numerical Weather Prediction

4052051, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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 Module component: Advanced Practical Course [T-PHYS-111421]

Coordinators: PD Dr. Michael Höpfner
Organisation: KIT Department of Physics
Part of: M-PHYS-105717 - Experimental Meteorology

Type	Credits	Grading	Term offered	Version
Coursework	2,5 CP	pass/fail	Each summer term	2

Courses					
ST 2025	4052103	Advanced Meteorological Practical Course	5 SWS	Practical course / 🗣	Wagner, Kohler, Knippertz, Höpfner
Exams					
ST 2025	7800026	Advanced Meteorological Practical Course			Sinnhuber

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

Assessment
Active participation in the experiments and timely submission of the practical course report. The practical course is passed as soon as both reports have been accepted by the lecturers. In case of non-acceptance of the report, the student has the possibility to improve it once. If the correction is also not accepted, the entire internship is considered "failed". In this case, both experiments must be repeated.

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
75 hours

Below you will find excerpts from courses related to this module component:

V Advanced Meteorological Practical Course

Practical course (P)
On-Site

4052103, SS 2025, 5 SWS, Language: English, Open in study portal

Content
Available experiments include:
• surface energy balance (IMKTRO)
• infrared spectroscopy (IMKASF)
• AIDA cloud and aerosol chamber (IMKAAF)

Organizational issues

- AIDA: 28.07. - 01.08.
- Energy balance: 10.06.-13.06.
- FTIR: May/June (TBD)

Please register for the ILIAS course to receive further information.

T 7.4 Module component: Applied Meteorology (Module Exam) [T-PHYS-111430]

Coordinators: Prof. Dr. Joaquim José Ginete Werner Pinto
Organisation: KIT Department of Physics
Part of: M-PHYS-105718 - Applied Meteorology

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each summer term	2

Exams			
ST 2025	7800023	Examination on Applied Meteorology (Module Exam)	Ginete Werner Pinto

Assessment
oral exam (see module description)

Modeled Prerequisites
The following conditions have to be fulfilled:

1. You have to fulfill one of 2 conditions:
    1. The module component T-PHYS-111428 - Energy Meteorology must have been passed.
    2. The module component T-PHYS-114348 - The Future of Weather and Climate Modeling (Literature Seminar) must have been passed.
2. The module component T-PHYS-111426 - Methods of Data Analysis must have been passed.
3. The module component T-PHYS-111427 - Turbulent Diffusion must have been passed.
4. The module component T-PHYS-111429 - Advanced Numerical Weather Prediction must have been passed.

Recommendations
None

Additional Information
None

Workload
120 hours

T 7.5 Module component: Arctic Climate System [T-PHYS-111273]

Coordinators: Prof. Dr. Björn-Martin Sinnhuber
Organisation: KIT Department of Physics
Part of: M-PHYS-105715 - Components of the Climate System

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	1 CP	pass/fail	Each winter term	1 semesters	3

Courses					
WT 25/26	4052101	Arctic Climate System	2 SWS	Lecture /	Sinnhuber

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

Assessment
The assessment consists of a coursework according to §4 (3) SPO MSc Meteorology and Climate Physics in the form of a short lecture (approx. 10 minutes) on a topic relevant to the llecture . The detailled conditions will be discussed in the lecture.

Prerequisites
None

Additional Information
Serreze, M., & Barry, R. (2014). The Arctic Climate System (2nd ed., Cambridge Atmospheric and Space Science Series). Cambridge: Cambridge University Press. doi:10.1017/CBO9781139583817

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Arctic Climate System

4052101, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content

- Basic climatic features of the Arctic
- Arctic atmospheric and ocean energy budgets
- Atmospheric circulation
- Energy exchange at the surface
- Sea ice
- Arctic ocean – sea ice – climate interactions
- Arctic amplification and Arctic change
- Modelling the Arctic climate system

Literature
Serreze, M., & Barry, R. (2014). **The Arctic Climate System** (2nd ed., Cambridge Atmospheric and Space Science Series). Cambridge: Cambridge University Press. doi:10.1017/CBO9781139583817

T 7.6 Module component: Atmospheric Aerosols [T-PHYS-111418]

Coordinators: Dr. Ottmar Möhler
Organisation: KIT Department of Physics
Part of: M-PHYS-105716 - Atmospheric Processes

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052041	Atmospheric Aerosols	2 SWS	Lecture /	Möhler
WT 25/26	4052042	Exercises to Atmospheric Aerosols	1 SWS	Practice /	Möhler, NN

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

Assessment
The students participating in the lecture on Atmospheric Aerosols with Exercises are expected to regularly participate in the Exercises. To pass the course, each student has to submit a solution for at least 50% of all exercises, and to present at least one solution to the tutor and the other participants.

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Atmospheric Aerosols

4052041, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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 7.7 Module component: Atmospheric Processes (Module Exam) [T-PHYS-111420]

Coordinators: Prof. Dr. Corinna Hoose
Organisation: KIT Department of Physics
Part of: M-PHYS-105716 - Atmospheric Processes

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	1

Exams			
ST 2025	7800016	Examination on Atmospheric Processes (Module Exam)	Hoose

Assessment
Oral exam (see module description).

Prerequisites
All module courses must be passed.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-PHYS-111416 - Cloud Physics must have been passed.
2. The module component T-PHYS-111417 - Energetics must have been passed.
3. The module component T-PHYS-111418 - Atmospheric Aerosols must have been passed.
4. The module component T-PHYS-111419 - Atmospheric Radiation must have been passed.

Recommendations
None

Additional Information
None

Workload
120 hours

T 7.8 Module component: Atmospheric Radiation [T-PHYS-111419]

Coordinators: PD Dr. Michael Höpfner
Organisation: KIT Department of Physics
Part of: M-PHYS-105716 - Atmospheric Processes

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052071	Atmospheric Radiation	2 SWS	Lecture /	Höpfner

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

Assessment
Short presentation at the end of the semester

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Atmospheric Radiation

4052071, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/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 7.9 Module component: Atmospheric Remote Sensing Infrastructures, Prerequisite [T-BGU-111185]

Coordinators: Prof. Dr. Jan Cermak
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-PHYS-105717 - Experimental Meteorology

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	1 CP	pass/fail	Each summer term	1 semesters	3

Courses					
ST 2025	4052201	Atmospheric Remote Sensing Infrastructures.	2 SWS	Lecture / 🗣	Cermak, Handwerker, Vüllers
Exams					
ST 2025	8297111185	Atmospheric Remote Sensing Infrastructures, Prerequisite			Cermak, Andersen, Vüllers

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The assessment consists of an ungraded coursework according based on successfully completed exercises wrt Atmospheric Remote Sensing Infrastructures. The students create a scientific presentation on a research instrument, research question and/ or field campaign, and present it to their peers. The focus of the presentation is on atmospheric remote sensing infrastructures as used at KIT and elsewhere. The total time required is approximately 15 hours.

Prerequisites
none

Workload
30 hours

T 7.10 Module component: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Coordinators: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each summer term	1 semesters	1

Assessment
Study achievement in the form of a presentation or a term paper or project work in the selected course.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
It is recommended that the basic seminar be completed during the same semester as the lecture series "Science in Society". If it is not possible to attend the lecture series and the basic seminar in the same semester, the basic seminar can also be attended in the semesters before the lecture series.
However, attending courses in the advanced unit before attending the basic seminar should be avoided.

T 7.11 Module component: Basics of Estimation Theory and its Application in Geoscience Remote Sensing [T-BGU-106822]

Coordinators: 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	Term offered	Version
Oral examination	4 CP	graded	Each summer term	1

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-BGU-106821 - Basics of Estimation Theory, Prerequisite must have been passed.
2. The module component T-BGU-106633 - Data Analysis in Geoscience Remote Sensing Projects, Prerequisite must have been passed.

T 7.12 Module component: Basics of Estimation Theory, Prerequisite [T-BGU-106821]

Coordinators: 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	Term offered	Version
Coursework	1 CP	pass/fail	Each summer term	1

T 7.13 Module component: Building and Environmental Aerodynamics [T-BGU-111060]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	3 CP	graded	Each term	1 semesters	1

Courses					
WT 25/26	6221905	Building and Environmental Aerodynamics	2 SWS	Lecture / Practice (/ 🗣	Gromke

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

Assessment
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Additional Information
none

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Building and Environmental Aerodynamics

6221905, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
The fundamentals of natural wind and its interaction with the built and natural environment are addressed in Building and Environmental Aerodynamics. Focus is on structural loads induced by wind, wind-induced vibrations of buildings and structures, and on flow phenomena in the natural and built environment, like wind shelter, cold air drainage and ventilation, urban air quality, and wind comfort.

T 7.14 Module component: Climate Modeling & Dynamics with ICON [T-PHYS-111412]

Coordinators: Prof. Dr. Joaquim José Ginete Werner Pinto
Organisation: KIT Department of Physics
Part of: M-PHYS-105715 - Components of the Climate System

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052151	Climate Modeling & Dynamics with ICON	2 SWS	Lecture /	Ginete Werner Pinto, Ludwig
WT 25/26	4052152	Exercises to Climate Modeling & Dynamics with ICON	1 SWS	Practice /	Ginete Werner Pinto, Lemburg, Hundhausen

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

Assessment
Successful participation in the exrcises.

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Climate Modeling & Dynamics with ICON

4052151, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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 7.15 Module component: Cloud Physics [T-PHYS-111416]

Coordinators: Prof. Dr. Corinna Hoose
Organisation: KIT Department of Physics
Part of: M-PHYS-105716 - Atmospheric Processes

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052081	Cloud Physics	2 SWS	Lecture /	Hoose, Keshtgar, Waman, Meusel
WT 25/26	4052082	Exercises to Cloud Physics	2 SWS	Practice /	Hoose, Keshtgar

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

Assessment
At least 50% of the points of the exercises have to be reached. At least once, a solution to one of the exercises has to be presented in class.

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Cloud Physics

4052081, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
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.

Organizational issues
Please sign up for more information in the Ilias course.

T 7.16 Module component: Components of the Climate System (Module Exam) [T-PHYS-111415]

Coordinators: Prof. Dr. Andreas Fink
Organisation: KIT Department of Physics
Part of: M-PHYS-105715 - Components of the Climate System

Type	Credits	Grading	Term offered	Version
Oral examination	4 CP	graded	Each term	2

Exams			
ST 2025	7800015	Examination on Components of the Climate System (Module Exam)	Fink

Assessment
Oral exam (see module description).

Modeled Prerequisites
The following conditions have to be fulfilled:

1. You have to fulfill 2 of 4 conditions:
    1. The module component T-PHYS-111410 - Seminar on IPCC Assessment Report must have been passed.
    2. The module component T-PHYS-111414 - Ocean-Atmosphere Interactions must have been passed.
    3. The module component T-PHYS-111413 - Middle Atmosphere in the Climate System must have been passed.
    4. The module component T-PHYS-111273 - Arctic Climate System must have been passed.
2. The module component T-PHYS-111411 - Tropical Meteorology must have been passed.
3. The module component T-PHYS-111412 - Climate Modeling & Dynamics with ICON must have been passed.

Recommendations
None

Additional Information
None

Workload
120 hours

T 7.17 Module component: Data Analysis in Geoscience Remote Sensing Projects, Prerequisite [T-BGU-106633]

Coordinators: Dr. rer. nat. Hendrik Andersen
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	Term offered	Version
Coursework	2 CP	pass/fail	Each winter term	5

Assessment
The assessment consists of a coursework based on a successful data analysis to address a geoscientific question. The analysis and the discussion of the results are submitted in a Jupyter Notebook. Regarding selected sessions of this lecture, in which the software details are jointly developed, students have to actively participate.

Further conditions regarding this lecture will be announced in the lecture.

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
60 hours

T 7.18 Module component: Data Science 1 [T-INFO-111622]

Coordinators: 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	Term offered	Version
Written examination	5 CP	graded	Each winter term	3

Exams			
ST 2025	7500199	Data Science 1 & Data Science 2	Böhm
WT 25/26	7500289	Data Science 1 & Data Science 2	Böhm, Schäfer, Nowack, Friederich

T 7.19 Module component: Database Systems [T-INFO-101497]

Coordinators: Prof. Dr.-Ing. Klemens Böhm
Organisation: KIT Department of Informatics
Part of: M-INFO-102980 - Informatics for Meteorology Students

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2025	24516	Datenbanksysteme	2 SWS	Lecture / 🗣	Böhm, Reimann
ST 2025	24522	Übungen zu Datenbanksysteme	1 SWS	Practice / 🗣	Böhm, Kalinke, Reimann
Exams					
ST 2025	7500166	Database Systems			Böhm, Neumann, Reimann
ST 2025	7500383	Database Systems			Reimann
WT 25/26	7500189	Database Systems			Böhm
WT 25/26	7500379	Database Systems			Böhm

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

T 7.20 Module component: Distributed Computing [T-INFO-101298]

Coordinators: Prof. Dr. Achim Streit
Organisation: KIT Department of Informatics
Part of: M-INFO-102980 - Informatics for Meteorology Students

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each winter term	2

Courses					
WT 25/26	2400050	Distributed Computing	2 SWS	Lecture / 🗣	Streit, Krauß, Schnepf

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60 minutes. Depending on the number of participants it will be announced six weeks before the assessment (§3 Abs. 3 SPO) if the assessment is done
• as an oral examination according to § 4 Abs. 2 No. 2 SPO or
• as a written examination according to § 4 Abs. 2 No. 1 SPO.

Prerequisites
None.

Recommendations
Knowledge in the area of computer networks helpful.

Below you will find excerpts from courses related to this module component:

V Distributed Computing

2400050, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture "Distributed Computing" provides an introduction to the world of distributed computing with a focus on the fundamentals and technologies of Grid and Cloud computing as well as the handling of Big Data. The lecture combines theory and application with the help of relevant application examples and common methods from science and business.

First, an introduction to the main characteristics of distributed systems is given. Then the topic of grid computing is discussed in more detail and the close relationship between Grid Computing and distributed data management is illustrated using the example of the WLCG, the infrastructure for distributing, storing and analyzing data from the particle accelerator at CERN. The topic of Cloud Computing is then discussed and contrasted with the previous section. After defining basic terms and concepts, virtualization is presented as one of the basic technologies of cloud computing; finally, common architectures, services and components in the cloud environment are discussed using examples and in general.

In the further course of the lecture, common procedures for authorization and authentication in distributed environments are discussed. The lecture includes a description of the basics of Authentication and Authorization Infrastructures (AAI) as well as different technologies, such as certificate or token-based procedures.

In a further thematic block, concepts for the management of large or distributed data are presented. Common tools and frameworks are discussed, as well as the life cycle of data, its metadata and data storage.

Finally, the topics of the lecture, grid computing, big data and cloud computing, are reflected and linked and different paradigms for data analysis are presented. Corresponding examples are introduced for each of the topics.

Success is assessed in the form of a written examination/e-exam (usually lasting 60 minutes) in accordance with Section 4 (2) No. 1 SPO. Depending on the number of participants, it will be announced six weeks before the examination (§ 6 Para. 3 SPO) whether the assessment will take place
- in the form of an oral examination in accordance with § 4 Para. 2 No. 2 SPO or
- in the form of a written examination/e-exam in accordance with § 4 Para. 2 No. 1 SPO
.

120 h / semester, of which 30 h attendance time and 90 h self-study due to the complexity of the subject matter

Literature

1. Andrew Tanenbaum, Maarten van Steen: “Distributed systems: principles and paradigms”, Prentice Hall, 2007, ISBN 0-13-613553-6
2. Ian Foster, Carl Kesselmann: “The Grid. Blueprint for a New Computing Infrastructure (2nd Edition)”, Morgan Kaufmann, 2004, ISBN 1-55860-933-4
3. Fran Berman, Geoffrey Fox, Anthony J.G. Hey: “Grid Computing: Making the Global Infrastructure a Reality”, Wiley, 2003, ISBN 0-470-85319-0
4. Tony Hey: “The Fourth Paradigm: Data-intensive Scientific Discovery”, Microsoft Research, 2009, ISBN 978-0-9825442-0-4
5. Rajkumar Buyya, James Broberg und Andrzej M. Goscinski: “Cloud Computing: Principles and Paradigms”, Wiley, 2011, ISBN 978-0-470-88799-8

T 7.21 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

Coordinators: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Additional Information
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

In the Advanced Module, students can choose their own individual focus, e.g. sustainable development, data literacy, etc. The focus should be discussed with the module coordinator at the FORUM.

T 7.22 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

Coordinators: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Additional Information
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 7.23 Module component: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

Coordinators: Dr. Christine Mielke
Christine Myglas

Organisation: General Studies. Forum Science and Society (FORUM)

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

Assessment
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Additional Information
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 7.24 Module component: Energetics [T-PHYS-111417]

Coordinators: Prof. Dr. Andreas Fink
Organisation: KIT Department of Physics
Part of: M-PHYS-105716 - Atmospheric Processes

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052131	Energetics	2 SWS	Lecture /	Fink

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

Assessment
Active participation

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Energetics

4052131, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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 7.25 Module component: Energy Meteorology [T-PHYS-111428]

Coordinators: apl. Prof. Dr. Stefan Emeis
Prof. Dr. Joaquim José Ginete Werner Pinto
Organisation: KIT Department of Physics
Part of: M-PHYS-105718 - Applied Meteorology

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each summer term	3

Courses					
ST 2025	4052191	Energy Meteorology	2 SWS	Lecture / 🗣	Emeis, Schroedter-Homscheidt, Ginete Werner Pinto
Exams					
ST 2025	7800021	Energy Meteorology			Ginete Werner Pinto

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
The students work in small groups on a task chosen at the beginning of the course on the topics of wind, solar or electricity grids. At the end, each student presents his or her results in a short presentation (max. 5 slides) followed by a discussion.

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Energy Meteorology

4052191, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

- Block Course: 07.07.-11.07.
- Seminar Room 214, building (11.40)
- Please register for the ILIAS course to receive further information

T 7.26 Module component: Experimental Meteorology (Module Exam) [T-PHYS-111425]

Coordinators: Prof. Dr. Björn-Martin Sinnhuber
Organisation: KIT Department of Physics
Part of: M-PHYS-105717 - Experimental Meteorology

Type	Credits	Grading	Term offered	Version
Oral examination	2 CP	graded	Each summer term	4

Exams			
ST 2025	7800038	Examination on Experimental Meteorology (Module Exam)	Sinnhuber

Assessment
Oral exam (see module description).

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

Modeled Prerequisites
The following conditions have to be fulfilled:

1. You have to fulfill one of 2 conditions:
    1. The following conditions have to be fulfilled:
        1. The module component T-PHYS-111421 - Advanced Practical Course must have been passed.
        2. The module component T-PHYS-111422 - Field Trip must have been passed.
        3. The module component T-BGU-111185 - Atmospheric Remote Sensing Infrastructures, Prerequisite must have been passed.
    2. The following conditions have to be fulfilled:
        1. The module component T-PHYS-113508 - Placeholder must have been passed.
2. The module component T-PHYS-111424 - Remote Sensing of Atmosphere and Ocean must have been passed.

Workload
60 hours

T 7.27 Module component: Field Course Soil Science [T-BGU-107486]

Coordinators: Prof. Dr. Wolfgang Wilcke
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103398 - Geoecology

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each summer term	1

Courses					
ST 2025	6111077	Field Course Soil Science (Geoecology)	0.5 SWS	Practice / 🗣	Wilcke, Basdediós Prieto, De Carvalho Teixeira
ST 2025	6111078	Field Course Soil Science (Geoecology)	0.5 SWS	Practice / 🗣	Wilcke, Basdediós Prieto, De Carvalho Teixeira

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
30 hours

T 7.28 Module component: Field Trip [T-PHYS-111422]

Coordinators: Prof. Dr. Joaquim José Ginete Werner Pinto
Organisation: KIT Department of Physics
Part of: M-PHYS-105717 - Experimental Meteorology

Type	Credits	Grading	Term offered	Version
Coursework	1,5 CP	pass/fail	Each summer term	2

Courses					
ST 2025	4052263	Field Trip	2 SWS	Excursion (E / 🗣	Hoose, Keshtgar
Exams					
ST 2025	7800037	Field Trip			Sinnhuber, Hoose

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Presentations on specific topics about the excursion

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
45 hours

Below you will find excerpts from courses related to this module component:

V Field Trip

4052263, SS 2025, 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

- Date: 5 days in August/September 2025
- Please register for the ILIAS course to receive further information

T 7.29 Module component: Flow Measurement Techniques [T-BGU-110411]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	3 CP	graded	Each term	1 semesters	1

Courses					
WT 25/26	6221907	Flow Measurement Techniques	2 SWS	Lecture / Practice (/	Gromke

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

Assessment
oral exam, appr. 30 min.

Prerequisites
none

Recommendations
none

Additional Information
none

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Flow Measurement Techniques

6221907, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
The course teaches the basics of flow measurement techniques as they are used in a wide variety of technical applications today. Measurement methods based on mechanical, electrical and optical principles are addressed in detail. Furthermore, methods of signal processing related to Fluid Mechanics and flow measurement techniques are presented, whereby basic evaluation procedures are explained.

T 7.30 Module component: Fluid Mechanics of Turbulent Flows [T-BGU-110841]

Coordinators: 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	Term offered	Expansion	Version
Oral examination	6 CP	graded	Each term	1 semesters	1

Courses					
ST 2025	6221806	Fluid Mechanics of Turbulent Flows	4 SWS	Lecture / Practice (/	Uhlmann
Exams					
ST 2025	8244110841	Fluid Mechanics of Turbulent Flows			Uhlmann

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

Assessment
oral exam, appr. 45 min.

Prerequisites
none

Recommendations
none

Additional Information
none

Workload
180 hours

T 7.31 Module component: Geo Data Infrastructures and Web Services [T-BGU-101756]

Coordinators: 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	Term offered	Version
Oral examination	1 CP	graded	Each summer term	2

Courses					
ST 2025	6026204	Geospatial Infrastructures and Web Services	1 SWS	Lecture / 🗣	Wursthorn
ST 2025	6026205	Geospatial Infrastructures and Web Services, Exercises	2 SWS	Practice / 🗣	Wursthorn
Exams					
ST 2025	8296101756	Geo Data Infrastructures and Web Services			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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-BGU-101757 - Geodata Infrastructures and Web-Services, Prerequisite must have been passed.

Workload
30 hours

T 7.32 Module component: Geodata Infrastructures and Web-Services, Prerequisite [T-BGU-101757]

Coordinators: 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	Term offered	Version
Coursework	3 CP	pass/fail	Each summer term	2

Courses					
ST 2025	6026204	Geospatial Infrastructures and Web Services	1 SWS	Lecture / 🗣	Wursthorn
ST 2025	6026205	Geospatial Infrastructures and Web Services, Exercises	2 SWS	Practice / 🗣	Wursthorn
Exams					
ST 2025	8296101757	Geodata Infrastructures and Web-Services, Prerequisite			Wursthorn

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

Workload
90 hours

T 7.33 Module component: Geological Hazards and Risk [T-PHYS-103525]

Coordinators: Dr. Andreas Schäfer
Organisation: KIT Department of Physics
Part of: M-PHYS-101833 - Geological Hazards and Risk

Type	Credits	Grading	Term offered	Version
Examination of another type	8 CP	graded	Each winter term	2

Courses					
WT 25/26	4060121	Geological Hazards and Risk	2 SWS	Lecture / 🗣	Schäfer, Rietbrock
WT 25/26	4060122	Exercises on Geological Hazards and Risk	2 SWS	Practice / 🗣	Schäfer, Rietbrock
Exams					
WT 25/26	7800114	Geological Hazards and Risk			Rietbrock

Legend: 💻 Online, 🎲 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Workload
240 hours

T 7.34 Module component: Geomorphology and Soil Science [T-BGU-107487]

Coordinators: Prof. Dr. Wolfgang Wilcke
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-BGU-103398 - Geoecology

Type	Credits	Grading	Term offered	Version
Written examination	8 CP	graded	Each summer term	1

Courses					
ST 2025	6111071	Soils of Europe	2 SWS	Lecture /	Wilcke
WT 25/26	6111061	Geomorphology and Pedology	2 SWS	Lecture /	Wilcke
WT 25/26	6111066	Geomorphology and Soil Science	1 SWS	Practice /	Basdediós Prieto, De Carvalho Teixeira
Exams					
ST 2025	8262101507_1	Geomorphology and Soil Science			Wilcke
WT 25/26	8262101507_2	Geomorphology and Soil Science			Wilcke

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

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
240 hours

T 7.35 Module component: Image Processing and Computer Vision [T-BGU-101732]

Coordinators: 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	Term offered	Version
Oral examination	3 CP	graded	Each winter term	1

Courses					
WT 25/26	6042101	Image Processing and Computer Vision, Lecture	2 SWS	Lecture / 🗣	Weinmann
WT 25/26	6042102	Image Processing and Computer Vision, Exercises	1 SWS	Practice / 🗣	Weinmann

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-BGU-106333 - Remote Sensing of a Changing Climate, Prerequisite must not have been started.
2. The module component T-BGU-106334 - Remote Sensing of a Changing Climate, Examination must not have been started.

Workload
90 hours

T 7.36 Module component: Introduction into Classification Methods of Remote Sensing [T-BGU-105725]

Coordinators: 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	Term offered	Version
Oral examination	3 CP	graded	Each summer term	2

Assessment
oral exam (approx. 20 min.)

Prerequisites
None

Recommendations
None

Additional Information
None

T 7.37 Module component: Introduction to General Relativity [T-PHYS-113186]

Coordinators: Prof. Dr. Thomas Schwetz-Mangold
Organisation: KIT Department of Physics
Part of: M-PHYS-106532 - Introduction to General Relativity

Type	Credits	Grading	Version
Oral examination	8 CP	graded	1

Courses					
WT 25/26	4022101	Introduction to General Relativity	3 SWS	Lecture /	Kahlhöfer
WT 25/26	4022102	Exercises to Introduction to General Relativity	1 SWS	Practice /	Kahlhöfer, Matuszak, Rathmann

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

T 7.38 Module component: Introduction to GIS for Students of Natural, Engineering and Geo Sciences [T-BGU-101681]

Coordinators: 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	Term offered	Version
Written examination	3 CP	graded	Each winter term	5

Courses					
WT 25/26	6071101	Introduction to GIS for Students of Natural Sciences, Engineering and Geosciences, L+E	4 SWS	Lecture / Practice (/ 🗣	Wursthorn
Exams					
ST 2025	8280101681	Introduction to GIS for Students of Natural, Engineering and Geo Sciences			Wursthorn

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

Assessment
written exam, 90 min.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-BGU-103541 - Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite must have been passed.

Workload
90 hours

T 7.39 Module component: Introduction to GIS for Students of Natural, Engineering and Geo Sciences, Prerequisite [T-BGU-103541]

Coordinators: 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	Term offered	Expansion	Version
Coursework	3 CP	pass/fail	Each winter term	1 semesters	5

Courses					
WT 25/26	6071101	Introduction to GIS for Students of Natural Sciences, Engineering and Geosciences, L+E	4 SWS	Lecture / Practice (/ 🗣	Wursthorn
Exams					
ST 2025	8280103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences			Wursthorn
WT 25/26	8280103541	Introduction to GIS for Students of Natural, Engineering and Geo Sciences			Wursthorn

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

Assessment
The achievement control takes place via accepted exercises.

Prerequisites
none

Recommendations
none

Additional Information
none

Workload
90 hours

T 7.40 Module component: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Coordinators: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	2 CP	pass/fail	Each summer term	1 semesters	1

Assessment
Active participation, learning protocols, if applicable.

Prerequisites
None

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendations
It is recommended that you complete the lecture series "Science in Society" before attending events in the advanced module and in parallel with attending the basic seminar.
If it is not possible to attend the lecture series and the basic seminar in the same semester, the lecture series can also be attended after attending the basic seminar.
However, attending events in the advanced module before attending the lecture series should be avoided.

Additional Information
The basic module consists of the lecture series "Science in Society" and the basic seminar. The lecture series is only offered during the summer semester.
The basic seminar can be attended in the summer or winter semester.

T 7.41 Module component: Machine Learning for Natural Sciences [T-INFO-110822]

Coordinators: Prof. Dr. Pascal Friederich
Organisation: KIT Department of Informatics
Part of: M-INFO-105630 - Machine Learning for Natural Sciences with Exercises

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each summer term	1

Courses					
ST 2025	2400008	Machine Learning for the Natural Sciences	2 SWS	Lecture / 🏵	Friederich
Exams					
ST 2025	7500211	Machine Learning for Natural Sciences			Friederich

Legend: 🖥 Online, 🏵 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Lecture: The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 90 minutes.

Exercise: The assessment is carried out in form of course work (German Studienleistung, § 4 Abs. 3 SPO). Students must regularly submit exercise sheets. The number of exercise sheets and the scale for passing will be announced at the beginning of the course. The assessment an only be repeated once.

Prerequisites
None.

Recommendations
• Knowledge of the basics of machine learning is helpful but not required
• Interest in natural science topics is required
• Basic knowledge of python is recommended. It has to be acquired during the semester through self-study

T 7.42 Module component: Machine Learning for Natural Sciences - Pass [T-INFO-111259]

Coordinators: Prof. Dr. Pascal Friederich
Organisation: KIT Department of Informatics
Part of: M-INFO-105630 - Machine Learning for Natural Sciences with Exercises

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each summer term	1

Courses					
ST 2025	2400034	Exercise for Machine Learning for the Natural Sciences	2 SWS	Lecture / Practice (/ 🏵	Friederich, Reiser, Zhou, Torresi, Neubert, Eberhard, Schlöder
Exams					
ST 2025	7500149	Exercise for Machine Learning for the Natural Sciences			Friederich

Legend: 📱 Online, 🏵 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Lecture: The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 90 minutes.

Exercise: The assessment is carried out in form of course work (German Studienleistung, § 4 Abs. 3 SPO). Students must regularly submit exercise sheets. The number of exercise sheets and the scale for passing will be announced at the beginning of the course. The assessment an only be repeated once.

Prerequisites
none.

Recommendations
• Knowledge of the basics of machine learning is helpful but not required
• Interest in natural science topics is required
• Basic knowledge of python is recommended. It has to be acquired during the semester through self-study

T 7.43 Module component: Machine Learning in Climate and Environmental Sciences [T-INFO-113083]

Coordinators: TT-Prof. Dr. Peer Nowack
Organisation: KIT Department of Informatics
Part of: M-INFO-106470 - Machine Learning in Climate and Environmental Sciences

Type	Credits	Grading	Term offered	Version
Written examination	6 CP	graded	Each winter term	2

Exams			
ST 2025	7500004	Machine Learning in Climate and Environmental Sciences	Nowack

Assessment
The assessment of the lectures is likely carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 60-120 minutes (exact duration to be confirmed).

Depending on the class size, this might be changed to an oral examination (lasting around 20 minutes, § 4 Abs. 2 No. 2 SPO). The exact type of assessment will be confirmed at least six weeks prior to the assessment.

Prerequisites
No strict prerequisites but several strong recommendations (see below).

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-INFO-113085 - Machine Learning in Climate and Environmental Sciences - Pass must have been started.

Recommendations
• Previous programming experience, e.g. in scientific contexts or in computer science, is required.
• Knowledge of fundamentals about machine learning is an advantage.
• Knowledge of the Python programming language is an advantage.
• Good knowledge of mathematical concepts such as linear algebra is an advantage.
• An interest in scientific questions important for the climate- and environmental sciences.

T 7.44 Module component: Machine Learning in Climate and Environmental Sciences - Pass [T-INFO-113085]

Coordinators: TT-Prof. Dr. Peer Nowack
Organisation: KIT Department of Informatics
Part of: M-INFO-106470 - Machine Learning in Climate and Environmental Sciences

Type	Credits	Grading	Term offered	Version
Coursework	0 CP	pass/fail	Each winter term	2

Exams			
ST 2025	7500380	Machine Learning in Climate and Environmental Sciences - Pass	Nowack

Assessment
The assessment is carried out in form of course work (German Studienleistung, § 4 Abs. 3 SPO). Students must regularly submit exercise sheets. The number of exercise sheets and the scale for passing will be announced at the beginning of the course. The assessment an only be repeated once.

Prerequisites
No strict prerequisites but several strong recommendations (see below).

Recommendations
• Previous programming experience, e.g. in scientific contexts or in computer science, is required.
• Knowledge of fundamentals about machine learning is an advantage.
• Knowledge of the Python programming language is an advantage.
• Good knowledge of mathematical concepts such as linear algebra is an advantage.
• An interest in scientific questions important for the climate- and environmental sciences.

T 7.45 Module component: Master's Thesis [T-PHYS-109616]

Coordinators: Prof. Dr. Corinna Hoose
Organisation: KIT Department of Physics
Part of: M-PHYS-105720 - Master's Thesis

Type	Credits	Grading	Term offered	Version
Final Thesis	30 CP	graded	Each term	1

Prerequisites
see module information

Final Thesis
This module component 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 7.46 Module component: Methods of Data Analysis [T-PHYS-111426]

Coordinators: Prof. Dr. Joaquim José Ginete Werner Pinto
Prof. Dr. Peter Knippertz
Organisation: KIT Department of Physics
Part of: M-PHYS-105718 - Applied Meteorology

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each summer term	3

Courses					
ST 2025	4052171	Methods of Data Analysis	2 SWS	Lecture / 🗣	Ginete Werner Pinto, Quinting
ST 2025	4052172	Exercises to Methods of Data Analysis	1 SWS	Practice / 🗣	Ginete Werner Pinto, Ramos
Exams					
ST 2025	7800022	Methods of Data Analysis (Prerequisite)			Ginete Werner Pinto

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Successful participation in the exercises.

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Methods of Data Analysis

4052171, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

- Please register for the ILIAS course to receive further information

V Exercises to Methods of Data Analysis

4052172, SS 2025, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
Following the lecture.

T 7.47 Module component: Middle Atmosphere in the Climate System [T-PHYS-111413]

Coordinators: PD Dr. Michael Höpfner
Dr. Miriam Sinnhuber
Organisation: KIT Department of Physics
Part of: M-PHYS-105715 - Components of the Climate System

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052061	Middle Atmosphere in the Climate System	2 SWS	Lecture /	Höpfner, Sinnhuber

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

Assessment
Short presentation at the end of the semester

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Middle Atmosphere in the Climate System

4052061, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/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, upper 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 7.48 Module component: Mobile Computing and Internet of Things [T-INFO-102061]

Coordinators: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-INFO-102980 - Informatics for Meteorology Students

Type	Credits	Grading	Term offered	Version
Written examination	2,5 CP	graded	Each winter term	7

Courses					
WT 25/26	2400051	Mobile Computing and Internet of Things		Lecture / Practice (	Beigl, Röddiger
Exams					
ST 2025	7500350	Mobile Computing and Internet of Things			Beigl
WT 25/26	7500287_1	Mobile Computing and Internet of Things			Beigl

Assessment
The assessment is carried out as a written exam (of approx. 60 minutes) as a digital exam according to §2 (3) of the Statute for the implementation of online examinations. The exam takes place ON SITE at KIT!

Prerequisites
Exercise certificate must be submitted.

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component Dictionary Error: Id brick.0x6C1ABC207FB644C5B48141E11F9AA526 in category mhbplus not found. - Dictionary Error: Id brick.0x6C1ABC207FB644C5B48141E11F9AA526 in category mhbplus not found. must have been started.

T 7.49 Module component: Modern Theoretical Physics for Teaching Degree Students [T-PHYS-103204]

Coordinators: PD Dr. Stefan Gieseke
Organisation: KIT Department of Physics
Part of: M-PHYS-101664 - Modern Theoretical Physics for Teaching Degree Students

Type	Credits	Grading	Term offered	Version
Oral examination	8 CP	graded	Each winter term	1

Courses					
WT 25/26	4012131	Moderne Theoretische Physik für Lehramtskandidaten	4 SWS	Lecture / 🗣	Gieseke
WT 25/26	4012132	Übungen zu Moderne Theoretische Physik für Lehramtskandidaten	2 SWS	Practice / 🗣	Gieseke, Kerner
Exams					
WT 25/26	7800080	Modern Theoretical Physics for Teacher Students			Gieseke

Legend: 🖥 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Assessment
Oral exam, approx. 45 min

Prerequisites
successful completion of the exercises

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-PHYS-103203 - Modern Theoretical Physics for Teaching Degree Students - Prerequisite must have been passed.

Workload
240 hours

T 7.50 Module component: Modern Theoretical Physics for Teaching Degree Students - Prerequisite [T-PHYS-103203]

Coordinators: PD Dr. Stefan Gieseke
Organisation: KIT Department of Physics
Part of: M-PHYS-101664 - Modern Theoretical Physics for Teaching Degree Students

Type	Credits	Grading	Term offered	Version
Coursework	0 CP	pass/fail	Each winter term	1

Courses					
WT 25/26	4012131	Moderne Theoretische Physik für Lehramtskandidaten	4 SWS	Lecture / 🗣	Gieseke
WT 25/26	4012132	Übungen zu Moderne Theoretische Physik für Lehramtskandidaten	2 SWS	Practice / 🗣	Gieseke, Kerner
Exams					
WT 25/26	7800078	Modern Theoretical Physics for Teacher Students - Prerequisite - Date 1			Gieseke
WT 25/26	7800079	Modern Theoretical Physics for Teacher Students - Prerequisite - Date 2			Gieseke

Legend: 💻 Online, 🌦 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Course achievement, successful completion of the exercises

Prerequisites
none

T 7.51 Module component: Modern Theoretical Physics I, Foundations of Quantum Mechanics [T-PHYS-112848]

Coordinators: Studiendekan Physik
Organisation: KIT Department of Physics
Part of: M-PHYS-106333 - Modern Theoretical Physics I, Foundations of Quantum Mechanics

Type	Credits	Grading	Term offered	Version
Oral examination	3 CP	graded	Each summer term	2

Courses					
ST 2025	4010141	Modern Theoretical Physics I, Foundations of Quantum Mechanics	4 SWS	Lecture / 🗣	Metelmann
ST 2025	4010142	Übungen zu Moderne Theoretische Physik I	2 SWS	Practice / 🗣	Metelmann, Díaz Naufal
Exams					
ST 2025	7800142	Modern Theoretical Physics I, Foundations of Quantum Mechanics- Examiner: A.Metelmann			Metelmann

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

Assessment
Oral exam, approx. 45 min

Prerequisites
successful completion of the exercises

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-PHYS-112728 - Modern Theoretical Physics I, Foundations of Quantum Mechanics, Prerequisite 1 must have been passed.

T 7.52 Module component: Modern Theoretical Physics I, Foundations of Quantum Mechanics, Prerequisite 1 [T-PHYS-112728]

Coordinators: Prof. Dr. Anja Metelmann
Organisation: KIT Department of Physics
Part of: M-PHYS-106333 - Modern Theoretical Physics I, Foundations of Quantum Mechanics

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	5 CP	pass/fail	Each summer term	1 semesters	1

Courses					
ST 2025	4010141	Modern Theoretical Physics I, Foundations of Quantum Mechanics	4 SWS	Lecture / 🗣	Metelmann
ST 2025	4010142	Übungen zu Moderne Theoretische Physik I	2 SWS	Practice / 🗣	Metelmann, Díaz Naufal
Exams					
ST 2025	7800064	Modern Theoretical Physics I, Foundations of Quantum Mechanics, Prerequisite 1 - Tutorial			Metelmann

Legend: 💻 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Course achievement, successful completion of the exercises

Prerequisites
none

T 7.53 Module component: Numerical Methods - Exam [T-MATH-111700]

Coordinators: apl. Prof. Dr. Peer Kunstmann
TT-Prof. Dr. Xian Liao
Prof. Dr. Wolfgang Reichel

Organisation: KIT Department of Mathematics

Part of: M-MATH-105831 - Numerical Methods

Type	Credits	Grading	Term offered	Version
Written examination	5 CP	graded	Each summer term	1

Courses					
ST 2025	0180300	Numerical Methods (Electrical Engineering, Meteorology, Remote Sensing, Geoinformatics)	2 SWS	Lecture	Tolksdorf
ST 2025	0180400	Tutorial for 0180300 (Numerical Methods (Electrical Engineering, Meteorology, Remote Sensing, Geoinformatics))	1 SWS	Practice	Tolksdorf
Exams					
ST 2025	7700088	Numerical Methods - Exam			Tolksdorf

Assessment
Success control takes the form of a written examination (120 minutes).

Prerequisites
none

T 7.54 Module component: Ocean-Atmosphere Interactions [T-PHYS-111414]

Coordinators: Prof. Dr. Andreas Fink
Organisation: KIT Department of Physics
Part of: M-PHYS-105715 - Components of the Climate System

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052121	Ocean-Atmosphere Interactions	2 SWS	Lecture /	Fink

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

Assessment
Active participation

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Ocean-Atmosphere Interactions

4052121, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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 7.55 Module component: Parallel Computer Systems and Parallel Programming [T-INFO-101345]

Coordinators: Prof. Dr. Achim Streit
Organisation: KIT Department of Informatics
Part of: M-INFO-102980 - Informatics for Meteorology Students

Type	Credits	Grading	Term offered	Version
Written examination	4 CP	graded	Each summer term	2

Courses					
ST 2025	24617	Parallel computer systems and parallel programming	2 SWS	Lecture	Streit, Barthel, Caspart
Exams					
ST 2025	7500365	Parallel Computer Systems and Parallel Programming			Streit
ST 2025	7500374	Parallel Computer Systems and Parallel Programming			Streit

T 7.56 Module component: Placeholder [T-PHYS-113508]

Coordinators: Studiendekan des KIT-Studienganges
Organisation: KIT Department of Physics
Part of: M-PHYS-105717 - Experimental Meteorology

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	6 CP	pass/fail	Irregular	1 semesters	1

T 7.57 Module component: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Coordinators: Dr. Christine Mielke
Christine Myglas
Organisation: General Studies. Forum Science and Society (FORUM)
Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading	Term offered	Version
Coursework	0 CP	pass/fail	Each term	1

Prerequisites
In order to register, it is mandatory that the basic module and the advanced module have been completed and that the grades for the partial performances in the advanced module are available.

Registration as a partial achievement means the issue of a certificate.

T 7.58 Module component: Remote Sensing of a Changing Climate, Examination [T-BGU-106334]

Coordinators: 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	Term offered	Version
Oral examination	3 CP	graded	Each winter term	3

Courses					
ST 2025	6043106	Satellite Climatology: Remote Sensing of a Changing Climate, Lecture	2 SWS	Lecture / 🗣	Cermak
ST 2025	6043107	Satellite Climatology: Remote Sensing of a Changing Climate, Exercises	1 SWS	Practice / 🧩	Andersen, Bruno

Legend: 💻 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
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 Prerequisites
The following conditions have to be fulfilled:

1. The module component T-BGU-106333 - Remote Sensing of a Changing Climate, Prerequisite must have been passed.
2. The module component T-BGU-101732 - Image Processing and Computer Vision must not have been started.

Recommendations
None

Additional Information
None

T 7.59 Module component: Remote Sensing of a Changing Climate, Prerequisite [T-BGU-106333]

Coordinators: 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	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	1

Courses					
ST 2025	6043107	Satellite Climatology: Remote Sensing of a Changing Climate, Exercises	1 SWS	Practice /	Andersen, Bruno

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

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-BGU-101732 - Image Processing and Computer Vision must not have been started.

T 7.60 Module component: Remote Sensing of Atmosphere and Ocean [T-PHYS-111424]

Coordinators: Prof. Dr. Björn-Martin Sinnhuber
Organisation: KIT Department of Physics
Part of: M-PHYS-105717 - Experimental Meteorology

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	3 CP	pass/fail	Each summer term	1 semesters	3

Courses					
ST 2025	4052151	Remote Sensing of Atmosphere and Ocean	2 SWS	Lecture / 🗣	Sinnhuber
ST 2025	4052152	Exercises to Remote Sensing of Atmosphere and Ocean	1 SWS	Practice / 🗣	Sinnhuber, Bartenschlager
Exams					
ST 2025	7800024	Remote Sensing of Atmosphere and Ocean (Prerequisite)			Sinnhuber

Legend: 🖥 Online, 🌀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Remote Sensing of Atmosphere and Ocean

4052151, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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 2025, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
Following the lecture.

Organizational issues

- Please register for the ILIAS course to receive further information

T 7.61 Module component: Satellite Climatology: Remote Sensing of a Changing Climate, Examination [T-BGU-110305]

Coordinators: Dr. rer. nat. Hendrik Andersen
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	Term offered	Expansion	Version
Oral examination	3 CP	graded	Each winter term	1 semesters	1

Courses					
ST 2025	6043106	Satellite Climatology: Remote Sensing of a Changing Climate, Lecture	2 SWS	Lecture / 🗣	Cermak
ST 2025	6043107	Satellite Climatology: Remote Sensing of a Changing Climate, Exercises	1 SWS	Practice / 🧩	Andersen, Bruno
Exams					
ST 2025	8297110305	Satellite Climatology: Remote Sensing of a Changing Climate, Examination			Cermak

Legend: 💻 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Oral exam (about 20 min.)

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, Prerequiste must be passed.

Modeled Prerequisites
You have to fulfill one of 2 conditions:

1. The module component T-BGU-110304 - Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste must have been passed.
2. The module component T-BGU-101732 - Image Processing and Computer Vision must not have been started.

Workload
90 hours

T 7.62 Module component: Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste [T-BGU-110304]

Coordinators: Dr. rer. nat. Hendrik Andersen
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	Term offered	Expansion	Version
Coursework	1 CP	pass/fail	Each summer term	1 semesters	2

Courses					
ST 2025	6043106	Satellite Climatology: Remote Sensing of a Changing Climate, Lecture	2 SWS	Lecture / 🗣	Cermak
ST 2025	6043107	Satellite Climatology: Remote Sensing of a Changing Climate, Exercises	1 SWS	Practice / 🧩	Andersen, Bruno
Exams					
ST 2025	8297110304	Satellite Climatology: Remote Sensing of a Changing Climate, Prerequiste			Cermak, Andersen

Legend: 💻 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Success is assessed in the form of an ungraded coursework. Analysis and evaluation of remote sensing datasets in scripts written by the students. The students will hand in their results in the form of scripts and/or a report on the findings. Approximately four such exercises are to be completed, the overall time demand is about 15 hours. The detailed conditions will be announced in the lecture and ILIAS.

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

Modeled Prerequisites
The following conditions have to be fulfilled:

1. The module component T-BGU-106333 - Remote Sensing of a Changing Climate, Prerequisite must not have been started.
2. The module component T-BGU-101732 - Image Processing and Computer Vision must not have been started.

Workload
30 hours

T 7.63 Module component: Scientific Concept Development [T-PHYS-111548]

Coordinators: Prof. Dr. Corinna Hoose
Organisation: KIT Department of Physics
Part of: M-PHYS-105719 - Specialization Phase

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	30 CP	pass/fail	Each term	1 semesters	1

Courses					
ST 2025	4052904	Seminar on Specialization Phase	2 SWS	Seminar /	Fink, Hoose, Klose-Albinger, Knippertz, Kunz, Leisner, Ginete Werner Pinto, Keshtgar
Exams					
ST 2025	7800098	Scientific Concept Development			Hoose

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

Prerequisites
see module information or module handbook

Workload
900 hours

Below you will find excerpts from courses related to this module component:

V Seminar on Specialization Phase

4052904, SS 2025, 2 SWS, Language: English, Open in study portal

Seminar (S)
Blended (On-Site/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

Organizational issues

- The organization will still take place online. Therefore please register for the ILIAS course to recieve further information

T 7.64 Module component: Self Assignment MSc Meteorology and Climate Physics (graded) [T-PHYS-111772]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	2 CP	graded	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.65 Module component: Self Assignment MSc Meteorology and Climate Physics (graded) [T-PHYS-111771]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Version
Examination of another type	2 CP	graded	Each term	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.66 Module component: Self Assignment MSc Meteorology and Climate Physics (ungraded) [T-PHYS-111769]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each term	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.67 Module component: Self Assignment MSc Meteorology and Climate Physics (ungraded) [T-PHYS-111770]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Version
Coursework	2 CP	pass/fail	Each term	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.68 Module component: Self Assignment MSc Meteorology and Climate Physics 1 CP (graded) [T-PHYS-112131]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	1 CP	graded	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.69 Module component: Self Assignment MSc Meteorology and Climate Physics 1 CP (graded) [T-PHYS-112132]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	1 CP	graded	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.70 Module component: Self Assignment MSc Meteorology and Climate Physics 1 CP (ungraded) [T-PHYS-112134]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	1 CP	pass/fail	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.71 Module component: Self Assignment MSc Meteorology and Climate Physics 1 CP (ungraded) [T-PHYS-112133]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	1 CP	pass/fail	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.72 Module component: Self Assignment MSc Meteorology and Climate Physics 3 CP (graded) [T-PHYS-112135]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	3 CP	graded	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.73 Module component: Self Assignment MSc Meteorology and Climate Physics 3 CP (ungraded) [T-PHYS-112136]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	3 CP	pass/fail	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.74 Module component: Self Assignment MSc Meteorology and Climate Physics 4 CP (graded) [T-PHYS-112137]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Examination of another type	4 CP	graded	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.75 Module component: Self Assignment MSc Meteorology and Climate Physics 4 CP (ungraded) [T-PHYS-112138]

Organisation: KIT Department of Physics
Part of: M-PHYS-105877 - Interdisciplinary Qualifications

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	4 CP	pass/fail	Each term	1 semesters	1

Self Service Assignment of Supplementary Studies
This module component can be used for self service assignment of grades acquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- Studienkolleg
- MINT-Kolleg
- Personalentwicklung und Berufliche Ausbildung

T 7.76 Module component: Seminar on IPCC Assessment Report [T-PHYS-111410]

Coordinators: Prof. Dr. Joaquim José Ginete Werner Pinto
Organisation: KIT Department of Physics
Part of: M-PHYS-105715 - Components of the Climate System

Type	Credits	Grading	Term offered	Version
Coursework	1 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052194	Seminar on IPCC Assessment Report	2 SWS	Advanced seminar (/)	Ginete Werner Pinto, Hundhausen

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

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

Prerequisites
none

Recommendations
none

Additional Information
none

Workload
30 hours

Below you will find excerpts from courses related to this module component:

V Seminar on IPCC Assessment Report

4052194, WS 25/26, 2 SWS, Language: English, Open in study portal

Advanced seminar (HS)
Blended (On-Site/Online)

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 7.77 Module component: The Future of Weather and Climate Modeling (Literature Seminar) [T-PHYS-114348]

Coordinators: Prof. Dr. Corinna Hoose
Dr. rer. nat. Behrooz Keshtgar
Prof. Dr. Peter Knippertz
Dr. Marlon Maranan

Organisation: KIT Department of Physics

Part of: M-PHYS-105718 - Applied Meteorology

Type	Credits	Grading	Term offered	Expansion	Version
Coursework	1 CP	pass/fail	Each summer term	1 semesters	2

Courses					
ST 2025	4052214	Literaturseminar "The Future of Weather and Climate Modelling"	2 SWS	Seminar / 🗣	Keshtgar, Knippertz, Hoose
Exams					
ST 2025	7800131	The Future of Weather and Climate Modeling (Literature Seminar)			Ginete Werner Pinto

Legend: 💻 Online, 🌐 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
Coursework is assessed based on two components: presentations (60% of the final grade) and active participation in discussions (40%). Each student will give a presentation followed by a discussion (details on the format will be explained during the introductory sessions). Presentations should cover the paper's broader context, highlighting key findings. For participation, students will read the assigned papers before each session and actively contribute to the discussions.

Prerequisites
none

Workload
30 hours

T 7.78 Module component: Tropical Meteorology [T-PHYS-111411]

Coordinators: Prof. Dr. Peter Knippertz
Organisation: KIT Department of Physics
Part of: M-PHYS-105715 - Components of the Climate System

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each winter term	3

Courses					
WT 25/26	4052111	Tropical Meteorology	2 SWS	Lecture /	Knippertz
WT 25/26	4052112	Exercises to Tropical Meteorology	1 SWS	Practice /	Knippertz, Haupt, Li

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

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

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Tropical Meteorology

4052111, WS 25/26, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
Chapter 1: Introduction
Chapter 2: Climatology
Chapter 3: Theoretical Concepts
Chapter 4: Equatorial Waves
Chapter 5: Madden-Julian Oscillation
Chapter 6: Easterly Waves
Chapter 7: Tropical Cyclones
Chapter 8: Mesoscale Convective Systems

Organizational issues
Please sign up for more information in the Ilias course.

T 7.79 Module component: Turbulent Diffusion [T-PHYS-111427]

Coordinators: Prof. Dr. Corinna Hoose
Dr. Gholamali Hoshyaripour
Organisation: KIT Department of Physics
Part of: M-PHYS-105718 - Applied Meteorology

Type	Credits	Grading	Term offered	Version
Coursework	3 CP	pass/fail	Each summer term	3

Courses					
ST 2025	4052081	Turbulent Diffusion	2 SWS	Lecture / 🗣	Hoshyaripour, Hoose
ST 2025	4052082	Exercises to Turbulent Diffusion	1 SWS	Practice / 🗣	Hoshyaripour, Hoose, Chopra
Exams					
ST 2025	7800019	Turbulent Diffusion (Prerequisite)			Ginete Werner Pinto

Legend: 💻 Online, 🖧 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Assessment
There are 7 exercises with 100 points in total.

To pass the prerequisite students must:

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

Prerequisites
None

Recommendations
None

Additional Information
None

Workload
90 hours

Below you will find excerpts from courses related to this module component:

V Turbulent Diffusion

4052081, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

- Please register for the ILIAS course to receive further information

V

Exercises to Turbulent Diffusion

4052082, SS 2025, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
There are 7 exercises with 100 points in total. To pass the prerequisite 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 7.80 Module component: Visualization [T-INFO-101275]

Coordinators: Prof. Dr.-Ing. Carsten Dachsbacher
Organisation: KIT Department of Informatics
Part of: M-INFO-102980 - Informatics for Meteorology Students

Type	Credits	Grading	Term offered	Version
Oral examination	5 CP	graded	Each summer term	1

Courses					
ST 2025	2400175	Visualisierung	2 SWS	Lecture / 🗣	Dachsbacher, Piochowiak
Exams					
ST 2025	7500193	Visualization			Dachsbacher
WT 25/26	7500563	Visualization			Dachsbacher

Legend: 💻 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 7.81 Module component: Wildcard [T-PHYS-106797]

Organisation: University
Part of: M-PHYS-103403 - Module Wildcard Electives

Type	Credits	Grading	Term offered	Version
Examination of another type	5 CP	graded	Each term	1

T 7.82 Module component: Wildcard [T-PHYS-106795]

Organisation: University
Part of: M-PHYS-103403 - Module Wildcard Electives

Type	Credits	Grading	Term offered	Version
Examination of another type	3 CP	graded	Each term	1

T 7.83 Module component: Wildcard [T-PHYS-106794]

Organisation: University
Part of: M-PHYS-103403 - Module Wildcard Electives

Type	Credits	Grading	Version
Examination of another type	2 CP	graded	1

T 7.84 Module component: Wildcard [T-PHYS-106796]

Organisation: University
Part of: M-PHYS-103403 - Module Wildcard Electives

Type	Credits	Grading	Term offered	Version
Examination of another type	4 CP	graded	Each term	1

T 7.85 Module component: Wildcard [T-PHYS-108285]

Organisation: University
Part of: M-BGU-102759 - Computer Vision and Remote Sensing

Type	Credits	Grading	Version
Coursework	4 CP	pass/fail	1

T 7.86 Module component: Wildcard [T-PHYS-108286]

Organisation: University
Part of: M-BGU-102759 - Computer Vision and Remote Sensing

Type	Credits	Grading	Version
Coursework	4 CP	pass/fail	1

T 7.87 Module component: Wildcard [T-PHYS-108283]

Organisation: University
Part of: M-BGU-102759 - Computer Vision and Remote Sensing

Type	Credits	Grading	Version
Examination of another type	4 CP	graded	1

T 7.88 Module component: Wildcard [T-PHYS-108284]

Organisation: University
Part of: M-BGU-102759 - Computer Vision and Remote Sensing

Type	Credits	Grading	Version
Examination of another type	4 CP	graded	1