Institut für Geographie

Module Manual
Master Course Climate & Environmental Sciences (M.Sc.)

Winter Semester 2017/18

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Module Manual
Master Course Climate & Environmental Sciences (M.Sc.)

Institute of Geography
Friedrich-Alexander-Universität Erlangen-Nürnberg

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2 Content and structure of the Master Course Climate & Environmental Sciences

2.1 Concept of the Master Course

The international Master course Climate & Environmental Sciences prepares students for the international job market. The Master course offers a wide spectrum of themes and methods, and allows you to specialize in one of the following areas, which epitomize the research of our faculty:

- Climate Research
- Geoinformatics
- Environmental Research and Analysis

By choosing a specific suite of seminars and a corresponding topic for the master thesis in one of the key areas above, students are able to shape their own profile. You are trained in setting up self-responsible projects within demanding and educationally innovative courses, and in targeting both basic-science and socially relevant problems. You will be actively integrated in current research projects of the Institute, trained in the organization of research work, and in the process of implementing knowledge. Innovative teaching courses, i.e. the module RTC (Advanced Research Training Course), will qualify you for inter- and transdisciplinary exchanges, active collaboration and organization, and for solving spatial problems. Besides theory, you will be trained particularly in "state-of-the-art"-methods of applied science. At several occasions, you will be invited to select your own areas of interest within these training courses. We offer numerous fieldwork seminars in Germany and in other countries, and there is the opportunity to spend a period of study abroad in the frame of our international network of partner universities. Regular graduate-level courses cover current and cutting-edge topics in climate and environment within our key areas of research, while the module "Inter- /transdisciplinary Perspectives" serves to improve interdisciplinary and methodological skills. The set of modules and graduate courses allows students to achieve a deep and broad understanding of major topics related to the interactions between climate, humans, and the environment.

2.2 Structure of the Master Course

The international Master course Climate & Environmental Sciences is a two-year (4 academic semesters) interdisciplinary degree course that comprises 120 ECTS credit points. Language of tuition and assessment is English. The structure of the course program includes 6 modules plus the master thesis. As stated above, the program offers a wide range of courses allowing the students to deepen knowledge in accordance with their individual interests, and to follow their inspiration. Courses from the key areas of research are offered at regular intervals, and will be accompanied by the active integration of students in running research projects at the institute. Besides the selected emphasis area, the students will gain job-oriented *„soft skills"*, such as the introduction to research methods and research processes, the independent development and implementation of projects, and the training in different fields of science communication.
Upon successful completion of the course program, students will be awarded with the degree **M.Sc. Climate & Environmental Sciences.**

2.3 Qualification profile

The Master course Climate & Environmental Sciences aims to offer high-quality training for future scholars and for those pursuing a professional career, considering the needs of the international market. Typical fields are (yet are not limited to):

- Geoinformatics and Remote Sensing
- Landscape and Environmental Management and Planning
- Landscape Analysis and Lab-based Environmental Analysis
- Monitoring of Climate and Environment
- Geocommunication, Geomarketing
- Development and Inter-Organization Cooperations
- NGOs
- Review / Consulting
- Research and Science

3 Structure of the Programme and Recommended Study Plan

Module	Course	SWS				Total ECTS	Workload distribution per semester in ECTS[1)]				mein campus	Specification graded/non-graded examination	Factor grade
		L	E	P	S		1. Sem.	2. Sem.	3. Sem.	4. Sem.			
Compulsory Modules													
Scientific Working I	Scientific Writing and Communication				2	**5**	5				6001	Weekly assignment	**0**
Scientific Working II	Graduate Seminar				2	**5**		5			6002	Written paper (20-30 pages), 60 %, with oral presentation (45 min.), 40 %	**1**
RTC: Advanced Research Training Course	Advanced Research Training Course				4	**20**		10	10		6021	Research report (20-30 pages), 60 %, with oral presentation (30 min.), 40 %	**1**
Inter-/ Transdisciplinary Perspectives [2)]	Elective Module Courses	According to examination regulations of the elective modules				**10**	5				According to elective module	According to examination regulations of the elective modules	**0**
	Elective Module Courses	According to examination regulations of the elective modules					5				According to elective module		
Advanced Regional Geography I	Graduate Seminar				2	**5**		5			6031	Written paper (20-30 pages), 60 %, with oral presentation (45 min.), 40 %	**1**
Advanced Regional Geography II	Field Trip (min. 10 days)				10 days	**10**			10		6032	Report (10-15 pages)	**1**
					10	**55**	**15**	**20**	**20**	**0**			

Elective Modules [1) 3) 4)]													
Advanced Methods A	Depending on module				2	**5**		5			1750	Depending on module	**1**
Advanced Methods B	Depending on module				2	**5**			5		1750	Depending on module	**1**
Advanced Methods C	Depending on module				2	**5**			5		1760	Depending on module	**0**
					6	**15**	**0**	**5**	**10**	**0**			

Consolidation Modules - Emphasis on Climate Research [1)]													
Advanced Methods: Advanced Climate Data Analysis	Advanced Climate Data Analysis				2	**5**	5				6080	Weekly Assignment (Problem-solving issues within the broader context of Climate Data Analysis, max. 3 pages weekly) or written paper (max. 15 pages) [5)]	**1**
Advanced Methods: Modeling Physical Systems in the Climate	Modeling Physical Systems in the Climate				2	**5**	5				6085	Weekly Assignment (Problem-solving issues within the broader context of Modeling Physical Systems in the Climate, max. 3 pages weekly) or written paper (max. 15 pages) [5)]	**1**
Advanced Methods: Scripting for Remote Sensing of the Environment	Scripting for Remote Sensing of the Environment				2	**5**	5				6090	Weekly Assignment (Problem-solving issues within the broader context of Scripting for Remote Sensing, max. 3 pages weekly) or written paper (max. 15 pages) [5)]	**1**
Advanced Methods: Tree-Ring Analysis - Applied Dendroecology	Tree-Ring Analysis – Applied Dendroecology				2	**5**		5			6095	Weekly Assignment (Problem-solving issues within the broader context of Tree-Ring Analysis, max. 3 pages weekly) or written paper (max. 15 pages) [5)]	**1**
MT: Master Thesis	Master Thesis					**30**				25		Master Thesis (ca. 80 pages), 100 % and oral defense (ca. 30 Min.), 0 %	**2**
	Master Thesis Defense									5			
					8	**50**	**15**	**5**	**0**	**30**			

Consolidation Modules - Emphasis on Geoinformatics [1)]													
Advanced Methods: Microwave Remote Sensing	Microwave Remote Sensing				2	5	5				6110	Weekly Assignment (Problem-solving issues within the broader context of Microwave Remote Sensing, max. 3 pages weekly) or written paper (max. 15 pages) [5)]	**1**
Advanced Methods: Scripting for GIS analysis	Scripting for GIS Analysis				2	5	5				6115	Weekly Assignment (Problem-solving issues within the broader context of Scripting for GIS, max. 3 pages weekly) or written paper (max. 15 pages) [5)]	**1**
Advanced Methods: Scripting for Remote Sensing of the Environment	Scripting for Remote Sensing of the Environment				2	5	5				6090	Weekly Assignment (Problem-solving issues within the broader context of Scripting for Remote Sensing, max. 3 pages weekly) or written paper (max. 15 pages) [5)]	**1**
Advanced Methods: Remote Sensing: Spectroscopy and Analysis of Spectral Data	Remote Sensing: Spectroscopy and Analysis of Spectral Data				2	5		5			6120	Weekly Assignment (Problem-solving issues within the broader context of Spectroscopy and Analysis of Spectral Data, max. 3 pages weekly) or written paper (max. 15 pages) [5)]	**1**
MT: Master Thesis	Master Thesis					**30**				25		Master Thesis (ca. 80 pages), 100 % and oral defense (ca. 30 Min.), 0 %	**2**
	Master Thesis Defense									5			
					8	**50**	**15**	**5**	**0**	**30**			

Consolidation Modules - Environmental Analysis [1]													
Advanced Methods: Soil Science	Soil Science				2	5	5				6125	Weekly Assignment (Problem-solving issues within the broader context of Soil Science, max. 3 pages weekly) or written paper (max. 15 pages) [5]	**1**
Advanced Methods: Tree-Ring Analysis - Applied Dendroecology	Tree-Ring Analysis – Applied Dendroecology				2	5	5				6095	Weekly Assignment (Problem-solving issues within the broader context of Tree-Ring Analysis, max. 3 pages weekly) or written paper (max. 15 pages) [5]	**1**
Advanced Methods: Stable Isotope Analysis	Stable Isotope Analysis				2	5	5				6130	Weekly Assignment (Problem-solving issues within the broader context of Stabile Isotope Analysis, max. 3 pages weekly) or written paper (max. 15 pages) [5]	**1**
Advanced Methods: Remote Sensing: Spectroscopy and Analysis of Spectral Data	Remote Sensing: Spectroscopy and Analysis of Spectral Data				2	5		5			6120	Weekly Assignment (Problem-solving issues within the broader context of Spectroscopy and Analysis of Spectral Data, max. 3 pages weekly) or written paper (max. 15 pages) [5]	**1**
MT: Master Thesis	Master Thesis					**30**				25		Master Thesis (ca. 80 pages), 100 % and oral defense (ca. 30 Min.), 0 %	**2**
	Master Thesis Defense									5			
					8	**50**	**15**	**5**	**0**	**30**			
Total					**24**	**120**	**30**	**30**	**30**	**30**			

1) The specified distribution constitutes a recommendation only.
2) Selection from among the range of modules offered by the Faculty of Sciences and the Faculty of Engineering.
3) Selection from among modules that are not part of the chosen area of specialisation (consolidation modules). The range of elective modules is extendable.
4) The ungraded module can be replaced by an internship of at least six weeks.
5) The specific nature of examination depends on the particular nature of the course held in the particular semester. The specific nature of examination will be announced in the module handbook at the beginning of each semester.

4 Module Descriptions

4.1 Compulsory Modules

1	**Module specification**	**Scientific Working I**	**5 ECTS**
2	**Course types**	Graduate seminar: Scientific writing and communication (2 SWS)	5 ECTS
3	**Responsible persons**	Prof. Dr. Thomas Mölg Prof. Dr. Matthias Braun	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Seminar: - Introduction and analysis of different publication standards - Introduction and analysis of different research processes - Scientific writing of papers and proposals - Transfer of knowledge and science communication. - Presentation techniques
6	**Learning objectives and skills**	Seminar: the students - analyse different scientific designs of publications with a focus on structure, quality standards, and their placement within the academic system - learn the ethical principles of science and good scientific practice - analyse different forms and structures of proposals - learn different ways of transferring scientific knowledge to practice - learn standards of communicating scientific facts to the media and public
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1
9	**Applicability of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment, 0 %
11	**Grading**	Non-graded examination
12	**Course offering**	Winter semester
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	To be announced at the beginning of the term.

1	**Module specification**	**Scientific Working II**	**5 ECTS**
2	**Course types**	Graduate seminar (2 SWS)	5 ECTS
3	**Responsible persons**	Prof. Dr. Thomas Mölg Prof. Dr. Matthias Braun	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Graduate seminar: - In-depth study of selected, research-oriented topics in climate and environmental science
6	**Learning objectives and skills**	Graduate seminar: the students - evaluate the importance of the selected topics in climate and environmental research - develop a practice-oriented awareness for processes which have the potential to change society and environment - independently prepare and present a topic from climate and environmental science at high level, considering the trained standards of scientific working
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Written Paper (20-30 Pages), 60 %, with oral presentation (45 min.), 40 %
11	**Grading**	100 % module examination; written Paper (20-30 Pages), 60 %, with oral presentation (45 min.), 40 %
12	**Course offering**	Summer semester
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	To be announced at the beginning of the term.

1	**Module specification**	**Module RTC – Advanced Research Training Course**	**20 ECTS**
2	Course types	Seminar group sessions in agreement with the supervisors of the courses	20 ECTS
3	Responsible persons	Prof. Dr. Achim Bräuning Prof. Dr. Rupert Bäumler	

4	**Lecturers**	Lecturers and professors of Physical Geography
5	**Course content**	Design and implementation of a clearly defined research project of manageable size in time and content in accordance with and under guidance of the lecturers (course project); alternatively or in addition to it integration or participation in a current research project; herein taking over and independent processing of a defined scope
6	**Learning objectives and skills**	The students - independently design and systematically transfer problem-oriented questions within clear targets - select suitable methods to empirically treat the selected set of themes - identify adequate theoretical approaches and place the own research topic within the theoretical approach - be aware of and organize the logical demands of research projects - present methods and results competent and understandable to experts and non-experts
7	**Inividual course requirements**	n/s
8	**Integration in the curriculum**	Semester 2+3
9	**Applicability of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Research report (20-30 pages), 60 %, with oral presentation (30 min.), 40 %
11	**Grading**	100 % module examination; Research report (20-30 pages), 60 %, with oral presentation (30 min.), 40 %
12	**Course offering**	Summer semester & winter semester
13	**Work load**	Compulsory course attendance and self-study in total 600 h; in agreement with the lecturer.
14	**Duration**	2 semesters
15	**Course language**	English
16	**Recommended literature**	To be introduced at the beginning of the course.

1	**Module specification**	**Module INT: Inter-/Transdisziplinary Perspectives**	**10 ECTS**
2	**Course types**	Attendance of two modules of neighbouring disciplines, which meaningful support the selected key subjects	5 ECTS 5 ECTS
3	**Responsible persons**	Prof. Dr. Rupert Bäumler Prof. Achim Bräuning	

4	**Lectures**	Lecturers and professors of neighbouring disciplines
5	**Course content**	Supplement and extension of geographical topics from the perspectives of neighbouring disciplines
6	**Learning objectives and skills**	The students: - gain deepened knowledge of actual interdisciplinary questions within the selected key areas - know and reflect corresponding theoretical and methodical approaches and are able to apply these approaches - are able to embed such approaches within the academic system - understand, analyse and illustrate processes of climate and environment in the context of the key areas of research at the Institute
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	According to examination regulations of the elective modules
11	**Grading**	Non-graded examination
12	**Course offering**	Winter semester & summer semester
13	**Workload**	Compulsory course attendance and self-study in total 300 h; according to neighbouring disciplines
14	**Duration**	1-2 semester
15	**Course language**	English
16	**Recommended literature**	According to elective modules.

1	**Module specification**	**Advanced Regional Geography I**	**5 ECTS**
2	**Course types**	Graduate Seminar: Advanced Regional Geography (2 SWS)	5 ECTS
3	**Responsible persons**	Prof. Dr. Thomas Mölg Prof. Dr. Rupert Bäumler	

4	**Lectures**	Lecturers and professors of Geography
5	**Course content**	Preparational graduate seminar for the Module „Advanced regional Geography II: In-depth analysis of the geographical aspects of a specific region and related problems, of selected topics in theory and practice, and synthesis of facets of cultural and physical geography
6	**Learning objectives and skills**	Preparational graduate seminar for Module „Advanced regional Geography II: The students - evaluate geographical aspects and problems of a specific region - develop theoretical and practical syntheses for facets of cultural and physical geography of a specific region
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 2 or 3
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Written paper (20-30 pages), 60 %, with oral presentation (45 min.), 40 %
11	**Grading**	100 % module examination; written paper (20-30 pages), 60 %, with oral presentation (45 min.), 40 %
12	**Course offering**	Winter semester & summer semester
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	To be announced at the beginning of the term.

1	**Module specification**	**Advanced Regional Geography II**	**10 ECTS**
2	**Course types**	Field trip (min. 10 days) Attendance compulsory	10 ECTS
3	**Responsible persons**	Prof. Dr. Thomas Mölg Prof. Dr. Rupert Bäumler	

4	**Lectures**	Lecturers and professors of Geography
5	**Course content**	Extended field seminar: application of the acquired knowledge of the graduate seminar „Advanced Regional Geography I“ in a specific region
6	**Learning objectives and skills**	Extended field seminar: the students - work independently and apply the acquired knowledge on-site - train and apply methods in natural and social sciences - examine and evaluate relevant topics on-site and develop a practice-oriented awareness for complex problems and questions - train teamwork on-site under new and challenging conditions, and thereby increase social skills - master the associated intercultural communication Competences can only be acquired „on site“, attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 2 + 3
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Report (10-15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter semester & summer semester
13	**Workload**	Field trip: 300 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	To be announced at the beginning of the term.

4.2 Elective Modules

1	**Module specification**	**Advanced Methods**	**5 ECTS**
2	**Course types**	Seminar: Advanced Methods	5 ECTS
3	**Responsible persons**	Prof. Dr. Rupert Bäumler, Prof. Dr. Matthias Braun, Prof. Dr. Achim Bräuning, Prof. Dr. Thomas Mölg	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Development and extension of analytical skills by additional method seminars which are not part of the selected specialization modules. The program of compulsory elective modules can be extended.
6	**Learning objectives and skills**	- Depending on module
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 2 + 3
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Depending on module
11	**Grading**	Depending on module
12	**Course offering**	Winter semester & summer semester
13	**Workload**	150 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	

4.3 Consolidation Modules – Emphasis on Climate Research

1	**Module specification**	**Advanced Methods – Advanced Climate Data Analysis**	**5 ECTS**
2	**Course types**	Seminar: Advanced Climate Data Analysis Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Thomas Mölg	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to the analysis of climate data & meteorological data
6	**Learning objectives and skills**	The students - understand the major principles of data availability and production; - practice different statistical methods for the problems at hand; - understand the importance of different space/time scales for the analysis and interpretation of climate data; - and are aware of the pitfalls of different types of climate data, which puts them in the position to make correct interpretations; A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Climate Data Analysis, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course

1	**Module specification**	**Advanced Methods – Modeling Physical Systems in the Climate**	**5 ECTS**
2	**Course types**	Seminar: Modeling Physical Systems in the Climate Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Thomas Mölg	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to the numerical modeling of the climate system
6	**Learning objectives and skills**	The students - understand the major principles of climate modeling; - put emphasis on model evaluation and uncertainty, and therefore appreciate the role of in-situ measurements; - know the strengths and weaknesses of models for a correct interpretation of model results; - and understand the importance of different space/time scales for model formulations and limitations; A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Modeling Physical Systems in the Climate, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Summer term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course

1	**Module specification**	**Advanced Methods – Scripting for Remote Sensing of the Environment**	**5 ECTS**
2	**Course types**	Seminar: Scripting for Remote Sensing of the Environment Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Matthias Braun	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to the processing of Earth observation data
6	**Learning objectives and skills**	The students - understand the major principles of data availability and processing chains; - are able to prepare scripts towards an automated processing of Earth observation data; - know to customize and adopt existing algorithms for data processing; - understand advanced methods of data processing. A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Scripting for Remote Sensing of the Environment, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Summer term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course

1	**Module specification**	**Advanced Methods – Tree-Ring Analysis – Applied Dendroecology**	**5 ECTS**
2	**Course types**	Seminar: Tree-Ring Analysis – Applied Dendroecology Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Achim Bräuning	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to the processing of tree-ring data
6	**Learning objectives and skills**	The students - understand the major principles of tree ring research, wood anatomy and wood formation; - are able to prepare wood samples for macroscopic and microscopic analyses; - know how to measure various wood parameters, to evaluate quality of measurements and to synchronize and date tree-ring data series; - learn how to relate tree-ring data to environmental variables - understand advanced methods of data processing. A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course.

1	**Module specification**	**Module MT – Master Thesis**	**30 ECTS**
2	**Course types**	Master thesis Thesis defense	25 ECTS 5 ECTS
3	**Responsible persons**	Prof. Dr. Achim Bräuning Prof. Dr. Rupert Bäumler	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Independent production of a substantial written scientific work within six months and its thesis defense
6	**Learning objectives and skills**	The students - design a relevant scientific problem and are in charge of independent elaboration within a defined period - develop independent ideas and concepts to solve the scientific questions - intensively and critically reflect concepts, models, theories, terminologies, characteristics, limitations and academically accepted views of the field of subject and science in general - are able to independently apply and develop appropriate methods – even for new or unknown and interdisciplinary contexts – and to present the results to experts - are able to clearly present subject-specific contents in written and oral form to target groups - extent their ability of planning and organization in order to realize subject-specific projects
7	**Individual course requirements**	Successful graduation of modules of at least 60 ETCS credit points of the degree program
8	**Integration in the curriculum**	Semester 4
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Master Thesis (ca. 80 pages), 100 % and oral defense (ca. 30 min.), 0 %
11	**Grading**	100 % module examination
12	**Course offering**	Annual
13	**Workload**	Attendance and self-study in total 900 h; Please consider to register your master thesis **on time**, if you intend to successfully finish the master program at the end of the current semester (Winter term: 31.3.; summer term: 30.9.) Please consider as well, that - the defense of the thesis has to be passed within a limit of four weeks after submission of the thesis, and that - date of the defense corresponds to the date of the final performance. It is on your one responsibility to take care about the subject of the thesis and to sort out all dates and deadlines with the supervisor of your master thesis **in time**; please also consider possible periods of absence of your supervisor during the semester break. Submission deadline should be latest one month before end of the respective semester.
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	In agreement with the supervisor

4.4 Consolidation Modules – Emphasis on Geoinformatics

1	**Module specification**	**Advanced Methods – Microwave Remote Sensing**	**5 ECTS**
2	**Course types**	Seminar: Microwave remote sensing Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Matthias Braun	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to microwave remote sensing
6	**Learning objectives and skills**	The students - understand the principles of microwave remote sensing; - are able to process microwave remote sensing data; - know to customize and adopt scripts for data processing. A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Microwave Remote Sensing, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Summer term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course

1	**Module specification**	**Advanced Methods – Scripting for GIS Analysis**	**5 ECTS**
2	**Course types**	Seminar: Scripting for GIS Analysis Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Matthias Braun	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Automating Geographic Information System (GIS) workflows using a script language.
6	**Learning objectives and skills**	The students - have a deeper insight into GI-Systems. - are familiar with a free & open source programming language. - are able to use a script language to automate GIS workflows. A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Scripting for GIS, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course.

1	**Module specification**	**Advanced Methods – Scripting for Remote Sensing of the Environment**	**5 ECTS**
2	**Course types**	Seminar: Scripting for Remote Sensing of the Environment Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Matthias Braun	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to the processing of Earth observation data
6	**Learning objectives and skills**	The students - understand the major principles of data availability and processing chains; - are able to prepare scripts towards an automated processing of Earth observation data; - know to customize and adopt existing algorithms for data processing; - understand advanced methods of data processing. A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Scripting for Remote Sensing of the Environment, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Summer term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course

1	**Module specification**	**Advanced Methods – Remote Sensing: Spectroscopy and Analysis of Spectral Data**	**5 ECTS**
2	**Course types**	Seminar: Remote Sensing: Spectroscopy and Analysis of Spectral Data Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Matthias Braun	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to the advanced analysis of spectroscopy data
6	**Learning objectives and skills**	The students - understand the major principles of spectroscopy for remote sensing; - practice different state-of-the-art methods for an analysis of spectroscopy data; - understand the applicability, limitations, and pitfalls of these methods; - know potential applications of spectral analyses to topics in physical geography. A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Spectroscopy and Analysis of Spectral Data, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course

1	**Module specification**	**Module MT – Master Thesis**	**30 ECTS**
2	**Course types**	Master thesis Thesis defense	25 ECTS 5 ECTS
3	**Responsible persons**	Prof. Dr. Achim Bräuning Prof. Dr. Rupert Bäumler	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Independent production of a substantial written scientific work within six months and its thesis defense
6	**Learning objectives and skills**	The students - design a relevant scientific scope and are in charge of independent elaboration within a defined period - develop independent ideas and concepts to solve the scientific questions - intensively and critically reflect concepts, models, theories, terminologies, characteristics, limitations and academically accepted views of the field of subject and science in general - are able to independently apply and develop appropriate methods – even for new or unknown and interdisciplinary contexts – and to present the results to experts - are able to clearly present subject-specific contents in written and oral form to target groups - extent their ability of planning and organization in order to realize subject-specific projects
7	**Individual course requirements**	Successful graduation of modules of at least 60 ETCS credit points of the degree program
8	**Integration in the curriculum**	Semester 4
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Master Thesis (ca. 80 pages), 100 % and oral defense (ca. 30 Min.), 0 %
11	**Grading**	100 % module examination
12	**Course offering**	Annual
13	**Workload**	Attendance and self-study in total 900 h; Please consider to enroll your master thesis **on time**, if you intend to successfully finish the master program at the end of the current semester (Winter term: 31.3.; summer term: 30.9.) Please consider as well, that - the defense of the thesis has to be passed within a limit of four weeks after submission of the thesis, and that - date of the defense corresponds to the date of the final performance. It is on your one responsibility to take care about the subject of the thesis and to sort out all dates and deadlines with the supervisor of your master thesis **in time**; please also consider possible periods of absence of your supervisor during the semester break. Submission deadline should be latest one month before end of the respective semester.
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	In agreement with the supervisor

4.5 Consolidation Modules – Emphasis on Environmental Analysis

1	**Module specification**	**Advanced Methods – Soil Science**	**5 ECTS**
2	**Course types**	Seminar: Soil Science Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Rupert Bäumler	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Application of sampling techniques, analytical methods and data interpretation in soil science
6	**Learning objectives and skills**	The students - understand the major principles of soil related questions in theory and practice (field methods and analytical techniques) - practice field sampling techniques, preparation of soil samples, and lab analyses of soil physical and chemical parameters - learn how to run quality controls of soil analytical data - learn how to interpret analytical data subject to research questions - learn how to relate soil data to environmental issues - understand applicability and limitations of the applied methods A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course.

1	**Module specification**	**Advanced Methods – Tree-Ring Analysis – Applied Dendroecology**	**5 ECTS**
2	**Course types**	Seminar: Tree-Ring Analysis – Applied Dendroecology Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Achim Bräuning	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to the processing of tree-ring data
6	**Learning objectives and skills**	The students - understand the major principles of tree ring research, wood anatomy and wood formation; - are able to prepare wood samples for macroscopic and microscopic analyses; - know how to measure various wood parameters, to evaluate quality of measurements and to synchronize and date tree-ring data series; - learn how to relate tree-ring data to environmental variables - understand advanced methods of data processing. A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course.

1	**Module specification**	**Advanced Methods – Stable Isotope Analysis**	**5 ECTS**
2	**Course types**	Seminar: Stable Isotope Analysis Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Achim Bräuning	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Applications of stable isotope methods related to environmental research
6	**Learning objectives and skills**	The students - understand the major principles of stable isotope theory and methodology; - practice sample preparation techniques for stable isotope analysis; - understand the applicability, limitations, and pitfalls of this technique; - know potential applications of stable isotope data to topics in physical geosciences. Practical exercises illustrate the applicability of the method. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Stable Isotope Analysis, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course

1	**Module specification**	**Advanced Methods – Remote Sensing: Spectroscopy and Analysis of Spectral Data**	**5 ECTS**
2	**Course types**	Seminar: Remote Sensing: Spectroscopy and Analysis of Spectral Data Attendance compulsory	5 ECTS
3	**Responsible persons**	Prof. Dr. Matthias Braun	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Selected methods related to the advanced analysis of spectroscopy data
6	**Learning objectives and skills**	The students - understand the major principles of spectroscopy for remote sensing; - practice different state-of-the-art methods for an analysis of spectroscopy data; - understand the applicability, limitations, and pitfalls of these methods; - know potential applications of spectral analyses to topics in physical geography. A series of practical exercises builds on each other throughout the course. Results of these exercises will develop from individual contributions and small-group work, and from a discussion with the whole group. Course attendance is therefore compulsory.
7	**Individual course requirements**	n/s
8	**Integration in the curriculum**	Semester 1 + 2
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Weekly assignment (Problem-solving issues within the broader context of Spectroscopy and Analysis of Spectral Data, max. 3 pages) or written paper (max. 15 pages), 100 %
11	**Grading**	100 % module examination
12	**Course offering**	Winter term
13	**Workload**	Compulsory course attendance: 30 h Self-study: 120 h
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	Will be provided at the beginning of the course

1	**Module specification**	**Module MT – Master Thesis**	**30 ECTS**
2	**Course types**	Master thesis Thesis defense	25 ECTS 5 ECTS
3	**Responsible persons**	Prof. Dr. Achim Bräuning Prof. Dr. Rupert Bäumler	

4	**Lectures**	Lecturers and professors of Physical Geography
5	**Course content**	Independent production of a substantial written scientific work within six months and its thesis defense
6	**Learning objectives and skills**	The students - design a relevant scientific scope and are in charge of independent elaboration within a defined period - develop independent ideas and concepts to solve the scientific questions - intensively and critically reflect concepts, models, theories, terminologies, characteristics, limitations and academically accepted views of the field of subject and science in general - are able to independently apply and develop appropriate methods – even for new or unknown and interdisciplinary contexts – and to present the results to experts - are able to clearly present subject-specific contents in written and oral form to target groups - extent their ability of planning and organization in order to realize subject-specific projects
7	**Individual course requirements**	Successful graduation of modules of at least 60 ETCS credit points of the degree program
8	**Integration in the curriculum**	Semester 4
9	**Application of the module**	MSc Climate & Environmental Sciences
10	**Learning achievements**	Master Thesis (ca. 80 pages), 100 % and oral defense (ca. 30 Min.), 0 %
11	**Grading**	100 % module examination
12	**Course offering**	Annual
13	**Workload**	Attendance and self-study in total 900 h; Please consider to enroll your master thesis **on time**, if you intend to successfully finish the master program at the end of the current semester (Winter term: 31.3.; summer term: 30.9.) Please consider as well, that - the defense of the thesis has to be passed within a limit of four weeks after submission of the thesis, and that - date of the defense corresponds to the date of the final performance. It is on your one responsibility to take care about the subject of the thesis and to sort out all dates and deadlines with the supervisor of your master thesis **in time**; please also consider possible periods of absence of your supervisor during the semester break. Submission deadline should be latest one month before end of the respective semester.
14	**Duration**	1 semester
15	**Course language**	English
16	**Recommended literature**	In agreement with the supervisor

5 Notes on the workload definition

- One hour of class (45 min) corresponds to a one-hour (60 min) calculation of the work load.
- The calculation of the on-campus teaching corresponds to 15 weeks during the winter semester and 14 weeks during the summer semester. A semester hour (SWS) therefore corresponds to 15 hours / 14 hours in terms of semester load. The workload of one module corresponds to 30 hours per credit point on average, i.e. 5 credit points correspond to 150 hours, 10 credit points to 300 hours, and 15 credit points to 450 workload hours.