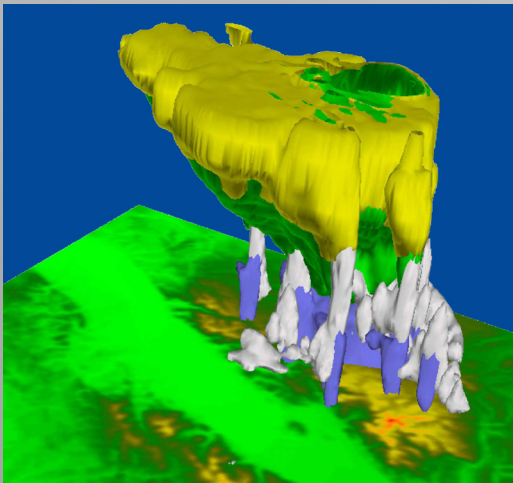


EARTH AND CLIMATE SYSTEM SCIENCE

Curriculum



Dear students

This curriculum provides you with comprehensive information on the Master's program in Earth System Science for all students beginning their studies in the winter semester 2017/18.

Please keep in mind that all information in this guide is subject to change. For the latest information please visit the website of the University of Hohenheim at **www.uni-hohenheim.de**.

Should you have further questions regarding your studies please visit our guide to advising at **www.uhoh.de/guide** or contact Dr. Andreas Behrendt at ess-counselling@uni-hohenheim.de.

We hope you enjoy your stay at the University of Hohenheim and wish you all the best for your studies!

Dean's Office of the Faculty of Natural Sciences &
Study Counsellors of Earth System Science

Study counselling Earth System Science

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Office hours: by appointment

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Program design

Final degree	Master of Science (M. Sc.)
Standard period of study	4 semesters (120 ECTS credits)
Type of program	Full-time, on site
Language of instruction	English

Contents and aims of the degree program

In the era of climate change, the understanding of the Earth system is of fundamental importance. Its components are interacting in a complex way. The Master's program in Earth System Science is both interdisciplinary and research-oriented. It requires the study of key processes of the Earth system, including human activities, food security and climate change. Thus, aspects of the natural sciences are linked to topics in the agricultural and social sciences. The focus of this program lies on the understanding and the simulation of Earth system components, such as the regional climate, particularly over the land surface, land use and land management as well as agricultural activities. The study program in Earth System Science conveys the following key skills and competencies.

As a graduate of this program, you will have acquired a comprehensive understanding of the Earth as a system. You know of the importance of an intact Earth system to humanity and are aware of the various ways in which human behaviour influences this system. You are able to determine and assess the Earth system's current status, while also being able to analyse and predict changes of the state of the Earth system by applying scientific methodologies. You are capable of objectively assessing your own methods and results as well as communicating them factually and clearly to fellow experts or laymen.

Learning outcomes

Below is a schematic overview of the learning outcomes for the program in Earth System Science. It helps you identify the knowledge and skills you acquire during the course of your studies.

	Professional skills	Cognitive skills	Key skills
	Upon completion of your studies you...		
Knowledge	<ul style="list-style-type: none"> understand the Earth as a system and are able to clearly explain the various compartments of the Earth system as well as their interrelations, even to laymen. are able to grasp new and unknown facts and developments related to the Earth system and thereby expand upon your already existing knowledge. 	<ul style="list-style-type: none"> are able to describe the principle of a method in detail from a natural scientific, agricultural or economic point of view. are able to comprehend and describe methods and (sets of) problems from a trans-disciplinary point of view. 	<ul style="list-style-type: none"> are able to develop creative problem-solving strategies. are able to work efficiently towards a goal, both independently and as part of a team. are able to design, coordinate, execute and analyze diverse projects. possess the ability to correctly and diligently conduct scientific work and you can transfer this attitude to other non-scientific areas of operation.
Application	<ul style="list-style-type: none"> know how to create computer simulations and models for natural scientific, agricultural and economic phenomena and combine these with descriptions of the Earth system to arrive at a holistic representation of the Earth system at a given time. can employ your subject-specific knowledge in a problem-oriented manner. 	<ul style="list-style-type: none"> know how to use the modelling system WRF-NOAH-MP for creating simulations of soil, vegetation and atmosphere and use these to find solutions to challenges in weather and climate research. are able to use visualization and analysis software such as IDL and Matlab can adapt knowledge generated in the areas of weather and climate research to meet the needs of end-users, e.g. in politics, industry and hydrology, and allow for the development of inter- and transdisciplinary methods. 	<ul style="list-style-type: none"> can take part and contribute to (scientific) discussions as well as moderate them. know how to deal with contrary opinions in a productive and fair manner. are able to confidently give presentations. know how to express yourself appropriately in spoken and written form.
Analysis	<ul style="list-style-type: none"> know how to derive concrete and practical courses of action for society and industry from your research-based conclusions in order to foster a sustainable development of the Earth system. can implement existing methods in strategies and know how to modify existing methods when required to suit a particular problem. are able to analyze your own methods and strategies and optimize them if necessary. 	<ul style="list-style-type: none"> are able to synthesize developments in all areas of the Earth system for state and private institutions according to their specific needs. 	

Structure of the program

During the course of the two-year study program in Earth System Science, modules in the amount of a minimum of 120 credits, including the Master's thesis, have to be completed successfully. This includes

- **compulsory modules** in the amount of a minimum of **54 credits**,
- **elective modules** in the amount of a minimum of **36 credits**,
- **Master's thesis** which awards **30 credits**.

The table below shows the structure of the program and represents the ideal course of studies:

	6 credits		6 credits	6 credits	6 credits	6 credits
1 st semester	Lecture Series ESS	Economics for Earth System Science	Measurement, Modeling and Data Assimilation I	Physics of the Earth System	Chemistry of the Earth System	Biology of the Earth System and Biodiversity
2 nd semester	Climate History and Evolution of the Earth System	Debate Seminar	Energy and Water Regime at the Land Surface	Applied Mathematics for Earth System Science	Elective Modules You choose elective modules in the amount of 36 credits.	
3 rd semester	Land Use Economics					
4 th semester	Master's Thesis Earth System Science					

The first and partly the semester brings all students to the same advanced level of knowledge concerning mathematics, physics, chemistry, biology and economics. This ensures that all students are able to successfully complete the courses of the following semesters. The module "Lecture Series Earth System Science" provides an overview of current topics and introduces students to scientific staff members and their research projects at the University of Hohenheim.

The key aspect of Earth System Science is to transcend common boundaries of scientific disciplines. For this reason, the components of the Earth system are not separately covered in individual modules. Instead, the second semester courses "Climate History and Evolution of the Earth System" and "Energy and Water Regime

at the Land Surface” cover cross-cutting topics essential for understanding the Earth system. These courses further impart awareness for interdisciplinary contexts.

Another focus of the program lies in measurements, their analysis and interpretation, as well as the application of computer models. Fundamental expertise in these areas is taught in the compulsory module “Measurement, Modeling and Data Assimilation I”. Measurements in the field will make up parts of this module. The collected data will be processed and analysed. This will also serve, amongst other things, as an introduction to data assimilation. This method connects measurement data with physical process descriptions in order to create an as complete as possible impression of the state of the Earth system at a given time. The results will be used to create models. Further knowledge on measurements and modelling can then be obtained within elective modules such as “Measurement, Modeling and Data Assimilation II” and “Remote Sensing of the Earth System” in the second semester. With the “Debate Seminar”, the second semester contains a unique element that serves to foster social and communication skills while applying knowledge you have obtained in the course of this program. Socio-economic modelling of land use decisions is the focus of the module “Land Use Economics” in the third semester.

With the completion of your **Master’s thesis** at the end of the fourth semester, you demonstrate your ability to do independent scientific work. If you want to complete your Master’s thesis at an institution outside of the University of Hohenheim, please see page 8 for further information.

Modules

The program in Earth System Science consists of compulsory and elective modules. You earn credits for each completed module. In order to complete a module, you need to pass the module examination as explained on page 13.

During the course of the two-year study program you need to complete:

- **compulsory modules** in the amount of a minimum of **50 credits**,
- **elective modules** in the amount of a minimum of **36 credits**,
- **Master's thesis** which awards **30 credits**.

Detailed information on individual modules, their corresponding courses, the current state of modules on offer as well as on how to register for exams may be obtained at www.uni-hohenheim.de/en/module-catalogue/studiengang/ess.

A tool for composing individual timetables is available in the intranet at www.uni-hohenheim.de/schedule.

Compulsory modules

The compulsory modules have to be completed by all students in order to obtain their degree. The compulsory modules are:

Compulsory modules winter semester (WS 17/18)

Module code	Module title	credits
1201-550	Lecture Series Earth System Science	2
1201-510	Economics for Earth System Science	4
1201-520	Measurement, Modeling and Data Assimilation I	6
1201-580	Physics of the Earth System	6
1301-460	Chemistry of the Earth System	6
2101-500	Biology of the Earth System and Biodiversity	6

Compulsory modules summer semester (SS 18)

Module code	Module title	credits
1201-560	Climate History and Evolution of the Earth System	4
3103-500	Energy and Water Regime at the Land Surface	6
1201-570	Debate Seminar	2
1101-440	Applied Mathematics for Earth System Science	6

Compulsory modules winter semester (WS 18/19)

Module code	Module title	credits
4904-430	Land Use Economics	6

Elective modules

Elective modules provide you with the opportunity to specialize in an area that corresponds to your personal and professional interests.

You may choose elective modules of the program in Earth System Science, of other natural science Master's programs of the University of Hohenheim and of other degree programs offered at the University of Hohenheim. If you want to take modules at other German or foreign universities, you need to petition the board of examiners. Please contact the examinations office for further information.

Elective modules summer semester 2018

Module code	Module title
1201-500	Remote Sensing of the Earth System
1201-530	Measurement, Modeling and Data Assimilation II
1201-620	Special Topics of Earth System Science
1301-400	Astrobiology
1301-430	Practical Course Chemical Evolution
3102-420	Project in Soil Sciences

Module code Module title

4101-410 Environmental and Resource Economics

3000-410 Portfolio Module (Master)

Elective modules winter semester 2018/19

Module code Module title

1201-590 Agricultural and Forest Meteorology

1301-430 Practical Course Chemical Evolution

3202-420 Global Change Issues

3202-430 Air Pollution and Air Pollution Control

3302-460 Plant Quality

3802-410 Ecology and Agroecosystems

3803-410 Natural Resource Use and Conservation in the Tropics and Subtropics

4201-440 Economics and Environmental Policy

4303-440 Social Conditions of Organic and Sustainable Agriculture

4303-470 Gender, Nutrition and Right to Food

4303-490 Ethics of Food and Nutrition Security

4901-420 Poverty and Development Strategies

4901-470 Quantitative Methods in Economics

3000-410 Portfolio Module (Master)

Master's thesis

Your Master's thesis shows that you are able to work independently on a topic in the field of earth system science within a period of six months by applying scientific methods. It is usually written during the fourth semester. Thesis work includes a literature review, compilation of original data derived from laboratory or field work as well as a period of write-up. You need to find a thesis supervisor – a professor or a *Privatdozent/in* – on your own.

The Master's thesis examination consists of a written part (thesis) as described above and, if applicable, an oral defense (colloquium). Whether a colloquium is part of the Master's thesis is decided by your supervisor. In the colloquium, you have to defend the essential arguments, methods and results of your thesis.

You have to register your Master's thesis with the Examinations Office immediately once your thesis supervisor has assigned the topic. Please use the form available online at uhoh.de/masterthesisess. You have to register your Master's thesis six months after you have passed your last module examination at the latest.

Recommendations for writing a Master's thesis¹

Length The Master's thesis should be approximately 50 to 80 pages long, excluding the bibliography and addendum.

Layout

Format

- Language: English
- Passive voice (“The experiment was designed to show...”)
- Continual paging
- Page margins: top: 2.5 cm; bottom: 2 cm; left: 3 cm, right: 2 cm
- Distance of header from top 1.25 cm; distance of footer from bottom: 1.25 cm
- Paper format DIN A4 (upright format)

Font

Choose a font that is big enough and easily legible, e.g. Arial, Times New Roman or Helvetica 12pt, (variables in equations and Latin names or the names of microorganisms: in italics).

¹ Deviations are possible in consultation with your supervisor.

1.5 line spacing. Grouped style is recommended.

Citing journals, books or the internet

The citational style has to be consistent – once a style has been chosen, you have to adhere to it throughout the text. The use of citation managing programs, such as RefManager or Endnote, is recommended.

An example for a journal citation:

Author A, author B, Title of the text, (acronym of the) journal volume, pages xx-yy (year)

An example for a book citation:

Author A, author B; in Title of the book; editor A; Publishing house, publishing place (year); pages xx-yy.

If you are using sources found on the internet (also see page 13), they have to be cited. The following information should be included in the citation:

Name, First name of the author, title of the publication, publishing organization if applicable, url, date of retrieval

Outline

Every Master's thesis should have the following outline:

1. Cover
2. Declaration of authorship
3. Table of contents
4. Introduction
5. Materials and methods
6. Results
7. Discussion
8. Conclusion
9. Summary in German and English
10. Bibliography
11. Addendum (if applicable)

Bibliography Material not authored by you, such as citations, research results, charts, photos, illustrations, etc., have to be clearly indicated.

The bibliography includes all citations in alphabetical or numerical order. We expect our students to engage with primary literature and reviews. Cited literature should always be up to date.

The use of any online encyclopedia, such as Wikipedia, or other commercial information material (company flyers, advertisement brochures, internet platforms) are not to be used.

Addendum Additional material, such as tables, extensive derivations, computer codes, etc., which would interrupt the flow of the text, are added here. Acknowledgments, dedications, etc. may be added to the Master's thesis. These are, however, not required and not given page numbers or included in the table of contents as they are not part of the scientific text.

Declaration of authorship At the beginning of the Master's thesis every student has to declare to be the sole author of the text. The text of this declaration is as follows (according to German law this text has to be in German, please find a translation below):

„Hiermit versichere ich, dass ich die vorliegende Arbeit selbstständig verfasst habe. Dabei wurden keine anderen als die angegebenen Quellen und Hilfsmittel verwendet. Wörtlich oder inhaltlich übernommene Stellen wurden als solche kenntlich gemacht.

Place, date

Signature

(“I hereby declare to be the sole author of this text. I have used no other than the cited sources and aides. Citations, direct or indirect, are marked as such.”)

Cover The layout for the cover page is on page 11.

UNIVERSITY OF HOHENHEIM
Name of the institute



Title of the Master's thesis

Master's Thesis

Degree program:

Handed in by
(Name)

Head of Department :
1. supervisor :
2. supervisor :
Topic issued on :
Date of submission :

Writing your Master's thesis outside the University of Hohenheim

Only if you are unable to find a suitable Master's thesis topic at the University of Hohenheim and only if a professor from Hohenheim agrees is it possible to write your thesis at an external institution. The external institution must provide proper conditions for conducting research at a university level. The topic for a Master's thesis may be issued and the thesis work supervised by a person who is not a full-time member of scientific staff at the Faculty of Natural Sciences, as long as the supervisor possesses qualifications equal to those of a professor at Hohenheim. This means that you can write your Master's thesis, e.g. at a research and development department of a company meeting the required scientific and academic standards and that a qualified person at that company may issue the thesis topic and supervise your work.

Please follow these steps, if you want to write your Master's thesis at an institution outside the University of Hohenheim:

1. Contact the professor heading the department corresponding to your desired thesis topic to seek approval to write your thesis outside of the University of Hohenheim. Discuss your thesis as well as the institution at which you would like to conduct your research with the professor. If your supervisor at the external institution is not a full-time scientific staff member at the Faculty of Natural Sciences, ask the professor to be your second supervisor. Further, the professor at Hohenheim has to agree to the thesis topic proposed by the external supervisor.
2. If the professor agrees to your proposed thesis work, you need to petition the examinations board in a formal letter for its approval. Please include the following information in your petition:
 - **Title** of your proposed thesis and an **exposé**
 - The **reason** for conducting your thesis work at an external facility
 - Name of your **external supervisor**
 - Name of your second **supervisor at Hohenheim**.
3. Once the examinations board has approved your petition, your supervisor may assign your topic and you must register the thesis immediately with the Examinations Office. Please use the form available online at **uhoh.de/masterthesisess**.

Submitting your Master's thesis

You are required to submit two bound copies of the Master's thesis to the Examinations Office before the deadline. In addition, you need to submit your thesis on a

digital medium (CD/DVD) for further examination purposes. Along with these documents, you have to submit a written declaration of authorship, declaring to be the sole author of the submitted work and that all sources and aids have been indicated as such.

Examinations

Every module of the Master's program in Earth System Science is completed with an examination. Types of examinations offered at the University of Hohenheim include written and oral examinations, protocols of practical courses, reports, preparation and presentation of contributions to seminars as well as colloquia. Information on examinations for specific modules may be found in the module catalog at **www.uni-hohenheim.de/en/module-catalogue**.

Registration

Examinations of non-block modules are usually held in two examination periods that follow the lecture period (see page 18). For the current registration period for exams please visit **www.uni-hohenheim.de/semesterdates**. You may choose whether to take the examination in the first or second examination period. You have to register for every examination you decide to take online through *Studium Online* at **www.uhoh.de/studiumonline**.

Once a registration for a module examination has been completed, the examination can no longer be dropped and you have to take the examination eventually. However, you have the option of withdrawing from an examination date you have previously registered for. If you want to withdraw from an examination date, you need to submit your withdrawal in writing to the Examinations Office seven calendar days before the examination date. In case of withdrawal, you are automatically registered for the upcoming examination date. Please note: withdrawing from an examination date does not cancel your registration for the examination. You cannot withdraw your registration for an examination, you only have the option of pushing the examination date.

Coursework may be a prerequisite for taking an examination. Please see the respective module description at **www.uni-hohenheim.de/en/module-catalogue** for detailed information on the specific requirements for taking an examination.

Information on the respective valid examination regulations, deadlines, examination dates, etc. may be obtained at the Examinations Office or online at **www.uni-hohenheim.de/exams**.

Examination resits

It is possible to resit an examination once. It is not possible to resit an examination which has already been passed.

If you fail an examination, you are notified by the examinations office in writing, usually including the resit date for which you are automatically signed up. Examination resits for blocked modules take place either in the upcoming examination period or are scheduled by the responsible professor. In some cases, the resit date has not been set at the time of notification. If this is the case, please check the resit dates with the respective professor or the Examinations Office.

Grading system

The examination result is expressed in grades according the grading table below. A minimum grade of 4.0 is required to pass an examination and complete a module. Modules Some modules are not graded and are either passed or failed.

	German	English
1,0 1,3	<i>sehr gut</i>	very good
1,7 2,0 2,3	<i>gut</i>	good
2,7 3,0 3,3	<i>befriedigend</i>	satisfactory
3,7 4,0	<i>ausreichend</i>	sufficient
5,0	<i>nicht ausreichend</i>	fail

Overall grade

The overall grade for the Master's program in Earth System Science is calculated as the weighted average of all grade scores achieved in all modules, including the Master's thesis. The module grades and the grade of the Master's thesis are weighted on the basis of the credits awarded for each completed module. The result is rounded mathematically to one decimal digit. Results above 4.0 are always rounded up to 5.0.

Recognition of credits obtained abroad

Credits obtained at another university during an exchange period can be recognized by the examinations board and thus contribute towards your degree. The awarding institution has to be equivalent to a German university and the competencies im-

parted by the courses taken must not exhibit substantial differences to the competencies of the program in Earth System Science.

Cheating and plagiarism

If you attempt to influence the result of an examination by cheating or using forbidden aids the respective examination is assessed with “fail” (5.0). This expressly includes plagiarism, i.e. the use of content taken from the internet or other sources without properly quoting or indicating the source.

Teaching staff may require you to attach a declaration of authorship to written examinations or assignments and demand them to be handed in in digital form. Please ask the respective supervisor before submitting your work.

Language courses

The Language Center of the University of Hohenheim offers courses in more than ten languages, including German.

For more information on German language courses please visit **www.spraz.uni-hohenheim.de/deutsch**.

For more information on the Language Center and all other language courses please visit **www.spraz.uni-hohenheim.de**.

Extending the period of study

The standard period of study is four semesters. However, you are not required to complete your studies within that time. There are ways and reasons to extend the period of study. The maximum period of study is seven semesters!

Extending the period of study before all modules are completed

If you have yet to complete your regular modules, excluding the Master’s thesis, it is possible to take a semester on leave (*Urlaubssemester*). During this time, you are free to spend a semester abroad and take courses and examinations at a host university. Completed modules can be recognized by the University of Hohenheim and thus contribute towards your degree. It is also possible to complete an internship, which may also be an extension of an internship done as part of an elective module (see page 10 for more information on internships).

A semester on leave provides you with the necessary flexibility to design the course of your studies on an individual basis. This does not necessarily extend your period

of study as examinations completed during an exchange semester, for example, can be fully recognized. For further information on reasons for being granted a semester on leave please visit www.uni-hohenheim.de/academicleaveofabsence.

Extending the period of study after all modules are completed

Once you have successfully completed your last module, with only the master's thesis left, you have six months before you are required to begin working on your thesis. However, please be aware that the maximum period of study is seven semesters, which cannot be extended. You may, of course, also opt to start writing your thesis right away.

These six months provide you with the opportunity to do an internship or spend a semester abroad. However, neither of these activities can be recognized since all credits necessary to complete your degree have already been accumulated.

For further information on exchange semesters please visit the website of the Office of International Affairs at exchange.uni-hohenheim.de.

Career prospects

The obtained degree allows for further academic qualification at universities or research centers. Another focus lies in consultancy for public officials, private companies or individuals. Corresponding jobs are offered by state or federal government agencies and offices, insurance companies and private consulting firms. Further, employment at international, bilateral and non-governmental organisations involved in development cooperation as well as environmental and food security is possible. For graduates with a talent for communication, science journalism is another attractive career possibility.

If you want to enter the job market outside academia, we would like to advise you to contact the CareerCenter for guidance. The CareerCenter Hohenheim is a service center and the first contact point for students and graduates for guidance when creating your own profile as well as assistance with your career entry and career planning. For more information please visit www.uni-hohenheim.de/careerentry.

Completing your studies

You have successfully completed your studies and would like to use your degree certificate to apply for a job? No problem, but please keep the following in mind:

- Only after you have completed all exams and all of your grades have been entered into the system can your diploma be issued. Once all grades have been entered into the system you may exmatriculate yourself and do not need to re-register for the next semester. If you exmatriculate or forego re-registration before all grades have been entered into the system, your studies are considered to have ended prematurely with exams either not taken or not entered into the system.
- If you re-register due to missing entries in the system, you do not have to pay the semester fees.

Semester dates

For detailed information on the semester dates please visit **www.uni-hohenheim.de/en/semester-dates**.

Contact

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