UNIVERSITÄT HOHENHEIM

Modulhandbuch

für den Studiengang

Master of Science Earth and Climate System Science

Stand Oktober 2023

Inhaltsverzeichnis

Modul: Agricultural and Forest Meteorology (1201-590)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	Within the ECSS degree programme, it is recommended that students have taken the compulsory modules "Weather and Climate Physics" and "Energy and Water Regimes at the Land Surface" before taking this module. The module is also open to students of other degree programmes, as it is not part of a profile or special subject combination.
Teilnahmevoraussetzung	Basic understanding about atmospheric processes, basic modules of the first semester of the master course.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 3. Semester, Wahl Bioeconomy (Master, PO vom 01.10.2014) 1. Semester, Wahl Bioeconomy (Master, PO vom 01.10.2014) 3. Semester, Wahl Earth and Climate System Science (Master, PO vom 01.10.2017) 3. Semester, Wahl Bioeconomy (ab WS 16/17) (Master, PO vom 01.04.2017) 1. Semester, Wahl Bioeconomy (ab WS 16/17) (Master, PO vom 01.04.2017) 3. Semester, Wahl
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The students develop a basic understanding for questions and methods used in agricultural and forest meteorology. They know the relationships between weather and climate on the one hand side and the different types of land surface on the other side and are capable to use this knowledge to solve interdisciplinary questions in applied meteorology.

	The students are capable to combine the competences learned in this module with their knowledge learned in the basis lectures of earth system sciences to work on interdisciplinary questions in agriculture and forestry.
empfohlene Vorkenntnisse	Interest in meterology in general and the relationship between meterology and agriculture and forestry in particular. Mathematical and physical knowledge is an advantage.
Anmerkungen	Maximum number of participants: 10
Modulprüfung und Gewichtung	Written examination (100%)
Studienleistung und Gewichtung	Active participation in both parts of the module
Agricultural and Forest Meteorology, Lecture (1201-591)	
Person(en) verantwortlich	Volker Wulfmeyer
Lehrform	Vorlesung
SWS	4
Inhalt	In the first part of the module, the basic understanding of atmospheric processes developed in earlier modules of the master course is briefly repeated and then complemented by details about the relationships between the atmosphere and the underlying land surface. Then the questions answered in agriculture and forest meteorology are presented to develop an understanding of the interrelation between weather and climate on the one side and agriculture, forests and forestry on the other side.
Literatur	-
Anmerkungen	-
Agricultural and Forest Meteorology, Exercise and Practical (1201-592)	
Person(en) verantwortlich	Volker Wulfmeyer
Lehrform	Übung mit Praktikum
SWS	2
Inhalt	The students solve exercises as preparation for the written examination as well as for deepening the material discussed in the lecture. Furthermore, this part of the module contains practical work with tools used in Agriculture and Forest Meteorology to deepen the understanding of the applied methodologies.
Literatur	-

Anmerkungen	-

Modul: Agricultural Production of Biobased Resources (3403-430)

Modulverantwortung	Iris Lewandowski
Bezug zu anderen Modulen	This module provides the basic knowledge on agricultural production of biobased resources that is needed to accomplish the Master Programme in Bioeconomy.
Teilnahmevoraussetzung	See admission regulations for the Master Programme Bioeconomy.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 semester
Studiengänge	Biobased Products and Bioenergy (Master) 3. Semester, elective Bioeconomy (Master) 1. Semester, semi-elective Earth and Climate System Science (Master), 1. Semester, compulsory
Prüfungsdauer (in Minuten)	60
Präsenzstudium (in Stunden)	52
Selbststudium (in Stunden)	128
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	Students have a sound knowledge of crop production in various agro-ecological zones and production systems. They are able to understand the conditions of agricultural production for biomass under different ecological and socio-economic settings. They investigate the natural resource base of agricultural production and have the skills to characterize material flows in agricultural systems, including agricultural products and their important links to livestock production. On this basis, they are able to develop concepts for the sustainable production of biomass for the biobased economy. Students are able to deal with complex natural systems. They understand the implications of this complexity on the agricultural production stage of biobased value chains. They gain the analytical skills and practice the critical thinking necessary to engage in the discussion on sustainable land-use systems and the implications of competing uses of biomass on food security. They are able to explain the role of agricultural production in the bioeconomy. They also

	gain skills in oral presentation, scientific writing, team work and interdisciplinary collaboration.
empfohlene Vorkenntnisse	-
Anmerkungen	Maximum number of participants: approx. 55. Prioritiy will be given to students for whom the module is compulsory.
Modulprüfung und Gewichtung	50% written exam
Studienleistung und Gewichtung	25% case study presentation including discussion, 25% case study written report
Agricultural Production of Biobased Resources (3403-431)	
Person(en) verantwortlich	Iris Lewandowski Regina Birner
Lehrform	Vorlesung
SWS	4
Inhalt	The overall objective of the module is to provide fundamental knowledge on the functioning of agricultural systems in different climatic zones for the production of biobased resources for the bioeconomy. Contents of the module include: • º Description, systematics and functioning of agro-ecosystems; º Provision of ecosystem services / hidden agricultural value chains; º Bio-physical principles of agricultural production; º Role of climate and climate change in agricultural production. • º Systematics, description and analysis of agricultural production systems in different agro-ecological regions; º Case studies in crop production; º In- and outputs and material flows in agricultural production systems; º Yields and quality of products from agricultural production; º Biomass supply systems; º Logistic aspects of biomass supply; º Biomass supply in the context of food security.
Literatur	https://link.springer.com/book/10.1007%2F978-3-319-68152-8

Anmerkungen	Limited number of participants (approx. 55) due to intensive supervision of presentations.

Modul: Astrobiology (1301-400)

Modulverantwortung	Henry Strasdeit
Bezug zu anderen Modulen	Nach Absprache mit dem Modulverantwortlichen kann das Modul Bestandteil der Spezialisierungsrichtung "Astrobiologie" sein (zusammen mit dem Forschungspraktikum Chemische Evolution und der Masterarbeit im Fachgebiet 130a).
Teilnahmevoraussetzung	Keine
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 2. Semester, Wahl Earth and Climate System Science (Master, PO vom 01.10.2017) 2. Semester, Wahl
Prüfungsdauer (in Minuten)	90
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	After having completed the module, the students should be able to explain important concepts and cause-and-effect relations in astrobiology. They can determine the ideas behind astrobiological statements. The students know basic chemical aspects of astrobiology (e. g., chemical compounds, chemical analytical methods) and can recall relevant details. They can also recall details of astrobiologically important research activities (e. g., space missions). The students should be able to exemplify astrobiologically important classes of objects, processes and concepts (e. g., types of meteorites, mass extinctions, biosignatures, characteristic properties of life). The students understand how laboratory experiments, field studies, astronomical observations and space missions expand our knowledge about the origin and evolution of life. They realize that life on Earth is and always was strongly influenced by cosmic phenomena and that life itself could be a cosmic phenomenon, that is, life may also exists on other planets and moons. During an excursion, the

	students acquire practical skills in recognizing the traces of an ancient asteroid impact. Furthermore, students should be able to deal with highly interdisciplinary problems by combining the methods and ways of thinking of various scientific disciplines. They know how to access the diverse and scattered literature of an interdisciplinary field and to present and discuss results from relevant publications
empfohlene Vorkenntnisse	Mindestens Grundkenntnisse in Biologie, Chemie und Physik, wie sie z.B. in den naturwissenschaftlichen Bachelorstudiengängen der Universität Hohenheim vermittelt werden. Interesse an Astronomie und Geologie ist hilfreich.
Anmerkungen	Places available: 14 Registration via ILIAS starting in January/February for the following summer semesterrn Places are assigned by the order of incoming registrations.
Modulprüfung und Gewichtung	Written examination on the material of the entire module.
Studienleistung und Gewichtung	participation at the excursion
Introduction to Astrobiology (1301-401)	
Person(en) verantwortlich	Henry Strasdeit
Lehrform	Übung mit Exkursion
SWS	2
Inhalt	The lecture includes the following topics: astronomical basics, chemical evolution from the interstellar medium to planetary systems, the early Earth, asteroid impacts, primordial volcanic islands, black smokers, past and present environmental conditions on Mars, biosignatures, habitability, the search for life on Mars, the icy moons of Jupiter and Saturn, planetary field analogues, extremophiles, survival of microorganisms in space, lithopanspermia, the possible role of minerals and salts in the origin of life, protocells and protometabolism, origin of biological homochirality, oldest traces of life, mass extinctions, „rare Earth“, SETI. The excursion leads to an asteroid impact crater, either the Nördlinger Ries or the Steinheimer Becken.

	It includes a field trip and a visit to the respective museum.
Literatur	Plaxco, K. W., Gross, M.: Astrobiology - A Brief Introduction, 2nd edition, Johns Hopkins University Press, Baltimore, 2011. Rothery, D. A., Gilmour, I., Sephton, M. A. (eds.): An Introduction to Astrobiology, revised edition, Cambridge University Press, Cambridge, UK, 2011. Sullivan III, W. T., Baross, J. A. (eds.): Planets and Life - The Emerging Science of Astrobiology, Cambridge University Press, Cambridge, UK, 2007. Pösges, G., Schieber, M.: The Ries Crater Museum Nördlingen, 2nd edition, Pfeil, München, 2015.
Anmerkungen	-

Key Experiments in Astrobiology (1301-402)

Person(en) verantwortlich	Henry Strasdeit
Lehrform	Vorlesung
SWS	1
Inhalt	This lecture gives an overview of seminal experiments in different fields of astrobiological research. Findings from laboratory and field studies, space missions, and astronomical and astrochemical observations will be presented. The focus will be on the practical aspects of simulation experiments, space missions, and chemical analyses. Some examples of the topics covered are (i) studies on the interstellar medium, exoplanets, and small celestial bodies (comets, asteroids, meteorites), (ii) experimental prebiotic chemistry: amino acids, Miller-type experiments, the formose reaction, protein and RNA world hypothesis, (iii) field studies at volcanic locations („hot-volcanic-coast scenario“), and (iv) analytical methods.
Literatur	Plaxco, K. W., Gross, M.: Astrobiology - A Brief Introduction, 2nd edition, Johns Hopkins University Press, Baltimore, 2011. Rothery, D. A., Gilmour, I., Sephton, M. A. (eds.): An Introduction to Astrobiology, revised edition, Cambridge University Press, Cambridge, UK, 2011. Sullivan III, W. T., Baross, J. A. (eds.): Planets and Life - The Emerging Science of Astrobiology, Cambridge University Press, Cambridge, UK, 2007.

Anmerkungen	The topics covered in this lecture are partly aligned to the contents of the “Practical course in chemical evolution”.
Seminar on Astrobiology (1301-403)	
Person(en) verantwortlich	Henry Strasdeit
Lehrform	Seminar
SWS	1
Inhalt	In this seminar, each student selects an astrobiological topic and presents it in a talk of 15 to 20 minutes duration (e. g., as PowerPoint presentation). A list of topics to choose from will be provided. After each talk, one of the students will chair the following discussion. Topics for the seminar are, for example, the early Earth environment, the concept of habitability, extremophiles, earliest records of life, lithopanspermia, planetary protection, and terraforming.
Literatur	Journal articles and book chapters on which the seminar talks are based.
Anmerkungen	-

Modul: Bioeconomy at European Level: EBU Label (3403-510)

Modulverantwortung	Iris Lewandowski
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	-
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	Beginn WS
Dauer des Moduls	1 semester
Studiengänge	Bioeconomy (Master) 3rd semester, elective Biobased Products and Bioenergy (Master) 3rd semester, elective Earth and Climate System Science (Master) 3rd semester, elective
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	60
Selbststudium (in Stunden)	120
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	By the end of the course, students will have acquired the main skills, competences and expertise to become an active change agent in the transformation towards a sustainable bioeconomy. Participants complete a series of activities to develop their profile within the field of the bioeconomy. This involves the acquisition of both bioeconomy-related academic knowledge as well as soft-skills in an international context. The EBU qualification supplement will encourage interdisciplinarity and collaboration between students from different European universities. In addition, it will reward individual activities such as participation in optional soft skills trainings, summer schools, student challenges, entrepreneurial activities, etc. The EBU certificate thus promotes a form of study which views the bioeconomy from different perspectives and encourages thinking outside the (disciplinary) box. After successful completion of this module, students should be able to: • Work in international as well as inter- and transdisciplinary groups

	• Understand how the bioeconomy relates to specific fields of research • Demonstrate the skills and competences necessary to play an active role in the development of the bioeconomy • Serve as active members of the bioeconomy at European level
empfohlene Vorkenntnisse	-
Anmerkungen	The EBU has developed a common qualification supplement, the “EBU label”, that will be granted to master students on bioeconomy-relevant study programs offered at the six EBU partner universities. It aims to upgrade existing disciplinary university curricula at master level by incorporating inter- and transdisciplinarity, cross-sectoral collaboration and sustainability competences. For the EBU qualification supplement to be granted, the following criteria must be fulfilled: 1. Enrolment in one of the following bioeconomy-relevant master programs: • Bioeconomy • Biobased Products and Bioenergy • Earth and Climate System Science 2. Self-reflection report on the student's own T-shaped skills profile consisting of disciplinary and interdisciplinary expertise, hard and soft skills as well as sustainability competences. 3. Completion of a master thesis with an explicit link to the bioeconomy through inclusion of a chapter describing the relevance and connection of the thesis results to the bioeconomy. Ideally, supervisor(s) and co-supervisor(s) should be academics from two different EBU universities. Students should select their supervisors according to the topic of interest. 4. Exchange semester at an EBU partner university or participation in the 'EBU Student Journey':

a.: An exchange semester at one of the following partner universities. This must be combined with participation in the MOOC (see below) and in one of the other additional activities listed in point 5:

- University of Bologna - Italy
- AgroParisTech- France
- University of Eastern Finland- Finland
- Wageningen University- the Netherlands
- University of Natural Resources and Life Sciences, Vienna (BOKU)- Austria
- Warsaw University of Life Sciences- Poland
- Swedish University of Agricultural Sciences – Sweden

b: Participation in the ‘EBU student journey’ must be combined with one of the additional activities listed in point 5. Students interested in participating in the journey must apply for it separately (for application rules, see elective course “EBU Student Journey”). Only 6 students will be selected per journey. By participating in the journey, you are expected to complete the other requirements for the EBU label.

5. Additional activities:

- Participation in the MOOC "Concepts of sustainable bioeconomy" (see elective course “ABBEE MOOC: Concepts of Sustainable Bioeconomy”). This activity is mandatory for students choosing option b above (exchange semester);
- Participation in soft-skill trainings, including digital skills and lifelong learning programs;
- Active participation in events/competitions/ workshops on the bioeconomy;
- Being proactive within the bioeconomy environment (entrepreneurship / activity in a bioeconomy student group / social media group).

After validation of the fulfilment of these criteria, students will receive certification of completion of the module. The module coordinator will also inform

	the examinations office and, once processed, your credits will be visible on HohCampus. Registration: Students must register for participation via ILIAS. In addition, participation in the courses “EBU Student Journey” and “MOOC: Concepts of Sustainable Bioeconomy” must be applied for separately. EBU Student Journey https://hohcampus.verw.uni-hohenheim.de/qisserver/pages/cm/exa/curricula/genericRailsSearchUnitsSimple.xhtml?_flowId=searchCourseOfStudyForModuleDescription-flow&_flowExecutionKey=e1s4 Only six students will be selected to participate in the EBU Student Journey. The next journey will take place in 2025 in the context of EBU Scientific Forum. Other students have the opportunity to complete the exchange semester (option a in the criteria of the module) to acquire the EBU qualification supplement. The students selected to participate in the journey must also apply for the EBU label. No credits will be granted for participation in the Journey only. Application for the "EBU Student journey" will be possible via ILIAS in December 2024. Preparatory online seminars and individual + group activities will be conducted before the on-site meeting. The exact dates of the on-site meeting will be announced prior to the application period in ILIAS and in https://european-bioeconomy-university.eu/education/ebu-label/ MOOC: Concepts of Sustainable Bioeconomy https://hohcampus.verw.uni-hohenheim.de/qisserver/pages/cm/exa/curricula/

	genericRailsSearchUnitsSimple.xhtml?_flowId=searchCourseOfStudyForModuleDescription-flow&_flowExecutionKey=e1s5 Participation requires prior registration. This self-paced online course will be permanently available on iversity (iversity.org) where students should register, complete all videos, quizzes, reading activities and self-reflection exercises. To be awarded the credits, students must register with the module coordinator (Prof. Dr. Iris Lewandowski) via email (nicole.gaudet@uni-hohenheim.de) to arrange a date for the exam. Students taking this exam are expected to apply for the EBU label.
Modulprüfung und Gewichtung	There is no set examination for this module. To receive the credits (ungraded), you must complete a number of module components - see "Comments" below.
Studienleistung und Gewichtung	-
EBU Student Journey (3403-511)	
Person(en) verantwortlich	Iris Lewandowski
Lehrform	Seminar mit Exkursion
SWS	3
Inhalt	Students participate in the EBU Scientific Forum taking place at an EBU partner university. In preparation for the forum, they work in teams to prepare a presentation on a cutting-edge bioeconomy-related topic to be given at the forum in the context of the ‘student challenge’. The teams consist of members from different EBU partner universities and are built during the preparatory online seminar. Through these activities and depending on the year’s focus, the EBU Student Journey will cover any number of the following skills: • Inter- and transdisciplinary skills based on a cross-sectorial mind-set • Sustainability competences including systems thinking, strategic competences, and normative competences • Personal and interpersonal skills including critical thinking, problem-solving, creativity,

	and others - International (digital) communication and collaboration skills • Management and entrepreneurial skills
Literatur	-
Anmerkungen	Only six students will be selected to participate in the EBU Student Journey per year. The other students will have the opportunity to follow the exchange semester (option b in the criteria of the module) to acquire the EBU qualification supplement. Application for the "EBU Student journey" will be possible for the whole month of February via ILIAS. Six participants from each EBU partner university will be selected per year (for selection criteria, see ILIAS). Preparatory online seminars and individual + group activities will be conducted before the on-site meeting. The exact dates of the on-site meeting will be announced prior to the application period.
MOOC: Concepts of Sustainable Bioeconomy (3403-512)	
Person(en) verantwortlich	Iris Lewandowski
Lehrform	E-Learning
SWS	1
Inhalt	This course describes the bioeconomy and its underlying concepts on a meta-level. The focus is on explaining the potential contribution of the bioeconomy to sustainability, including the role of innovation, governance and multi-stakeholder collaboration, as well as the importance of applying analytical methods to guide decision-making. This approach uses the concept of the biobased value chain as a transversal framework that combines biophysical, social, technological and economic elements. Special attention is given to the fundamentals of the bioeconomy such as systems thinking and inter- and transdisciplinarity. The course offers a space for reflection on the role of professionals in the bioeconomy. It serves as a baseline to enrich the bioeconomy dialogue, integrating a range of perspectives and dimensions. Given the plurality of bioeconomy perspectives, it is important to acknowledge that there is no 'one-size-fits-all' definition, and each

	interpretation is dependent on specific contexts. Against this background, the course explains different bioeconomy perspectives as well as the role of biobased resources and biological knowledge in shaping a sustainable bioeconomy. After completion of the course, students should be able to: • Recognize and understand diverse perspectives, underpinning concepts and principles of the bioeconomy and its potential to contribute to sustainability. • Explain the concept of the biobased value chain and the manifold sectors that are part of the bioeconomy. • Describe different holistic methods to measure sustainability in the bioeconomy. • Acknowledge the importance of innovation and inter-/transdisciplinary collaboration approaches for the transition towards a bioeconomy. • Discuss and interpret bioeconomy strategies and policies, identifying their components and governance mechanisms to foster the bioeconomy. • Identify stakeholders in the bioeconomy, their roles and influence in decision-making processes and the transition towards a sustainable bioeconomy.
Literatur	Lewandowski, I: Bioeconomy. Shaping the Transition to a Sustainable, Biobased Economy, Springer. https://doi.org/10.1007/978-3-319-68152-8, 2018
Anmerkungen	Places are limited and participation requires prior registration. This self-paced online course will be permanently available on iversity (iversity.org) where students should register, complete all videos, quizzes, reading activities and self-reflection exercises. To be awarded the credits, the students must register with the person responsible for the module via email (nicole.gaudet@uni-hohenheim.de) to arrange a date for the exam.

Modul: Bodenwissenschaftliches Experiment (3102-420)

Modulverantwortung	Ellen Kandeler
Bezug zu anderen Modulen	Dieses Modul hilft Studierenden, das Interesse an Bodenkunde zu vertiefen und ein Themenauswahl für die Masterarbeit und / oder Promotion zu treffen. _____ This module helps to deepen your interest in soil science and will help to focus your interest on a topic you want to choose for your master thesis and/or PhD.
Teilnahmevoraussetzung	Grundkenntnisse und fortgeschrittene Kenntnisse in Bodenwissenschaften _____ Basic and advanced knowledge in soil science is necessary!
Lehrsprache	deutsch/englisch
ECTS	7,5
Angebotshäufigkeit	jedes Semester
Dauer des Moduls	n. V.
Studiengänge	Agrarwissenschaften - Bodenwissenschaften (Master) 1./2. Semester, Wahlpflicht Earth and Climate System Science (Master) 2. Semester, Wahl Environmental Science - Soil, Water, and Biodiversity (Master) 2./3. Semester, Wahlpflicht _____ Agricultural Sciences - Soil Science (Master) 1./2. Semester, semi-elective Earth and Climate System Science (Master) 2. Semester, elective Environmental Science - Soil, Water, and Biodiversity (Master) 2./3. Semester, semi-elective
Prüfungsdauer (in Minuten)	30
Präsenzstudium (in Stunden)	70
Selbststudium (in Stunden)	155
Arbeitsaufwand (in Stunden)	225
Lern- und Qualifikationsziele	In dem Modul erhalten die Studierenden einen Einblick in die Themen der modernen Bodenwissenschaften. Sie können eine Fragestellung bearbeiten, Bodenproben analysieren, Ergebnisse interpretieren und präsentieren.

	_____ After successfully completing the module, students have an insight into selected topics of modern soil science. They can analyse soil samples, interpret and present the results.
empfohlene Vorkenntnisse	-
Anmerkungen	Die Studierenden können wählen, ob sie das Modul in Deutsch oder in Englisch belegen wollen. _____ Students are free to decide whether to conduct the module in English or German.
Modulprüfung und Gewichtung	schriftliche Ausarbeitung in Form eines Laborprotokolls (75%) und Präsentation mit Diskussion (25%) --------- written paper in the form of a laboratory report (75%) with presentation and discussion (25%)
Studienleistung und Gewichtung	-
Bodenwissenschaftliches Experiment (3102-421)	
Person(en) verantwortlich	Thilo Streck Ellen Kandeler Thilo Rennert
Lehrform	Seminar
SWS	4
Inhalt	Entsprechend Ihres Interesses können Sie ein Projekt unter Anleitung von: Biogeophysik (Prof. Streck) Bodenchemie (Prof. Rennert) Bodenbiologie (Prof. Kandeler) durchführen. In Zusammenarbeit mit einem Post Doc oder einem Doktoranden beteiligen Sie sich aktiv an neuen Forschungsfragen. Sie analysieren Bodenproben, werten ihre Ergebnisse aus und präsentieren sie in einem Seminar. Für weitere Informationen bezüglich der Inhalte dieser Veranstaltung wenden Sie sich bitte an Prof. Kandeler: Tel. 0711/4592-4220.
Literatur	Der Betreuer stellt Ihnen aktuelle Literatur zu Ihrem gewählten Thema zur Verfügung.
Anmerkungen	Es handelt sich um ein Seminar mit Übungen! Das Projekt kann nach Absprache mit dem Betreuer

	jederzeit begonnen werden. Dauer: 2-3 Wochen im Institut nach Vereinbarung

Modul: Chemistry of the Earth System & Pollution (1301-470)

Modulverantwortung	Moritz Kühnel
Bezug zu anderen Modulen	None
Teilnahmevoraussetzung	None
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Earth and Climate System Science (Master, PO vom 01.10.2017) 1. Semester, Pflicht Earth System Science (Master, PO vom 01.10.2013) 1. Semester, Pflicht
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	After having completed the module, the students know the most important substances (e. g., minerals) and compound classes of the Earth system and their relevant reactions. They can recall the relevant facts. The students understand the underlying chemical concepts and know how to apply them. They are able to perform calculations related to the properties of chemical substances in the Earth system (e. g., solubilities and redox potentials). The students comprehend the chemical aspects of the Earth system on a global scale as well as on the molecular level and acquire a differentiated view of anthropogenic impacts. The graduates of the module understand the basic physical and chemical processes in the tropo- and the stratosphere and in the earth system. The influence of air pollutants in the ambient air and on a global scale can be explained, which, in turn, allows classifying and assessing the air quality in a defined area. After having completed the module, the students know how to apply the scientific method to complex systems.

empfohlene Vorkenntnisse	Basic knowledge of chemistry, as taught e.g. in the natural science Bachelor's degree programmes at the University of Hohenheim.
Anmerkungen	In person with the module coordinator (this only applies to students of Master’s programmes other than ECSS)
Modulprüfung und Gewichtung	Written examination with two parts: a) anorganic and organic chemistry (25% each) b) chemistry of the atmosphere (50%)
Studienleistung und Gewichtung	Regular attendance
Organic Substances in the Earth System (1301-471)	
Person(en) verantwortlich	Claudia Bizzarri
Lehrform	Vorlesung
SWS	1
Inhalt	Initially, some important functional groups and reactions that are crucial for a proper understanding of organic chemistry will be repeated. This is followed by presentation and discussion of the most important classes of organic substances as well as selected compounds of the earth system. Their formation, properties, and (degradation) reactions will be discussed as far as they are relevant to the earth system.
Literatur	Hart, D.J., Hadad, C.M., Craine, L.E., Hart, H.: Organic Chemistry: A Short Course, Brooks/Cole, Belmont, 2012. or any other textbook of organic chemistry.
Anmerkungen	-
Inorganic Chemistry of the Earth’s Surface (1301-472)	
Person(en) verantwortlich	Moritz Kühnel
Lehrform	Vorlesung
SWS	1
Inhalt	The lecture is based on an integrative concept. The focus is on the chemical principles that can equally be applied to the description of the Earth’s solid surface and the bodies of water. Key topics of the lecture are: general chemical description of the

	Earth’s surface; mineral classes; rocks; weathering; solubility; mobilisation and immobilisation of metal ions; metal complex formation; ion exchange; adsorption; acid-base reactions; redox reactions; acidity; salt content; substances and their transport in the hydrosphere; anthropogenic impacts.
Literatur	Duke, C.V.A., Williams, C.D.: Chemistry for Environmental and Earth Sciences, CRC, Boca Raton, 2008. Andrews, J.E., Brimblecombe, P., Jickells, T.D., Liss, P.S., Reid, B.J.: An Introduction to Environmental Chemistry, 2nd edition, Blackwell, Malden, 2004. vanLoon, G.W., Duffy, S.J.: Environmental Chemistry - A Global Perspective, 4th edition, Oxford University Press, Oxford, 2017. Textbooks of general and inorganic chemistry (the most recent editions).
Anmerkungen	-
Chemistry of the Atmosphere (1301-473)	
Person(en) verantwortlich	Cosima Stubenrauch
Lehrform	Vorlesung
SWS	2
Inhalt	Structure of the atmosphere; radiation balance of the Earth; global balances of trace gases; chemical degradation mechanisms; stratospheric chemistry, ozone hole; tropospheric chemistry, photochemical smog; greenhouse effect, climate; spatial distribution of air pollutants in urban and rural areas; temporal variation and trends in air quality; meteorological influences.
Literatur	Jacob, D.J.: Introduction to Atmospheric Chemistry, Princeton University Press, Princeton, 1999. Zellner, R.: Global Aspects of Atmospheric Chemistry, Steinkopff, Darmstadt, 1999. Warneck, P.: Chemistry of the Natural Atmosphere, 2nd edition, Academic Press, San Diego, 2000. Baumbach, G.: Air Quality Control, Springer, Berlin, 1996.
Anmerkungen	The graduates of the module understand the basic physical and chemical processes in the tropo- and

	the stratosphere. The influence of air pollutants in the ambient air and on a global scale can be explained, which, in turn, allows classifying and assessing the air quality in a defined area.

Modul: Climate History and Evolution of the Earth System (1201-560)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	Alle Pflichtmodule des ersten Semesters.
Teilnahmevoraussetzung	Keine.
Lehrsprache	englisch
ECTS	4
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 2. Semester, Pflicht Earth and Climate System Science (Master, PO vom 01.10.2017) 2. Semester, Pflicht
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	42
Selbststudium (in Stunden)	78
Arbeitsaufwand (in Stunden)	120
Lern- und Qualifikationsziele	The students learn to think in larger spatial and longer temporal scales and recognize evolution as a universal phenomenon. They understand how climate and chemistry of the Earth system developed over long time scales and that it will further change in the future. In addition, the students can distinguish between natural and anthropogenic influences on the Earth system.
empfohlene Vorkenntnisse	Kenntnisse von Pflichtmodulen des erstes Semesters.
Anmerkungen	Maximum number of participants: 15
Modulprüfung und Gewichtung	Written examination: 50% about 'Climate History', 50% about 'Evolution of the Climate System'
Studienleistung und Gewichtung	None
Chemical Evolution (1201-561)	
Person(en) verantwortlich	Moritz Kühnel
Lehrform	Vorlesung
SWS	2
Inhalt	The students are introduced to the chemical and biological evolution as well as its complexity and emergence. They learn how chemical aspects determined the development of our solar system and about the chemical and physical conditions on the young planet Earth. In addition, prebiotic

	chemistry and the theories for the development of life on the planet are introduced and the development of the Earth is explained from a chemical point of view. Finally, today's chemical industry and the anthropogenic chemical evolution are considered.
Literatur	H. Rauchfuß: "Chemische Evolution und der Ursprung des Le-bens", Springer, Berlin.
Anmerkungen	-
Climate History (1201-562)	
Person(en) verantwortlich	Volker Wulfmeyer
Lehrform	Vorlesung
SWS	1
Inhalt	The students perform a journey through the 4.5 billion years of Earth and climate History. They learn about the governing natural forcing mechanisms like the Milankovich cycles or the influence of plate tectonics and today's anthropogenic influences on the climate system. The development of the atmosphere and the sequence of cold and warm episodes is described in detail including the development of the biosphere and its influence on climate. Finally, the radiation balance, the greenhouse effect and future climate scenarios are discussed
Literatur	Publications of the International Geosphere Biosphere Program
Anmerkungen	-
Climate History and Evolution of the Earth System (1201-563)	
Person(en) verantwortlich	Volker Wulfmeyer Moritz Kühnel
Lehrform	Übung
SWS	1
Inhalt	Exercise to deepen the content of the lecture „Climate History". The students select a subject and prepare a seminar talk. This talk is given to the whole group followed by a discussion.
Literatur	-
Anmerkungen	-

Modul: Debate Seminar (1201-570)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	All compulsory modules of the first semester.
Teilnahmevoraussetzung	Active participation in the lectures.
Lehrsprache	englisch
ECTS	2
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 Semester
Studiengänge	M.Sc. Earth System Science, 2. Semester, Pflicht M.Sc. Earth and Climate System Science, 2. Semester, Pflicht M.Sc. Bioeconomy, 3. Semester, Wahl (Profil: Innovation and Entrepreneuship in the Bioeconomy)
Prüfungsdauer (in Minuten)	45
Präsenzstudium (in Stunden)	30
Selbststudium (in Stunden)	30
Arbeitsaufwand (in Stunden)	60
Lern- und Qualifikationsziele	The students learn the standard formats of debates such as the British and Open Parliamentary Styles. They elaborate their own speeches based on rhetorical tools. Standard knowledge about the structure of speeches is acquired as well. By practical debates, they examine their skills to appear convincingly in discussions about topics in Earth System Science such as global and climate change.
empfohlene Vorkenntnisse	None.
Anmerkungen	Maximum number of participants: 10 Registration via ILIAS. Registration is open from the end of the winter semester until the beginning of the summer semester.
Modulprüfung und Gewichtung	Presentation
Studienleistung und Gewichtung	Preparing and conducting debates
Debate Seminar (1201-571)	
Person(en) verantwortlich	Volker Wulfmeyer
Lehrform	Seminar
SWS	2

Inhalt	In this seminar, the students learn to prepare and to perform a debate. Generally, the debate is performed based on the style of the "Open Parlamentary Debate". After the definition of a debate, the main ingredients of a good speech are presented based on the well-known and still applicable introductions of Aristotle. Then, the preparation, organization, and performance of a high-quality speech is trained including a good behavior of the speaker. One week in advance, a topic of the debate is formulated by the students, which relates to the contents of this class and is matter of a controversial discussion among experts and/or in the public. By a draw it is selected whether the students belong to the government, the opposition or to the free speakers in the debate. These groups perform the final preparation of he debate together and independently, i.e., they allocate arguments and arrange their appearance in the debate. In the debate, the speakers of these parties present their arguments within a prescribed time schedule. The lecture is closed with an open discussion between the audience and all students.
Literatur	The specific rules are handed out and explained to students in written form during a preliminary meeting.
Anmerkungen	-

Modul: Ecology and Agroecosystems (4906-410)

Modulverantwortung	Ingo Graß
Bezug zu anderen Modulen	This module will link-up knowledge from different subject areas in order to enable students to interpret reactions within agroecosystems coherently.
Teilnahmevoraussetzung	Basic knowledge of farming and/or closely related topics. This module is designed to accommodate a range of experience and knowledge levels in both ecology and agriculture. Students with only basic knowledge in ecology and biology should enlarge them before starting in this module. To maintain the high quality of this module and due to time and space constraints in planned group work, seminar presentations, and excursions we only accept a maximum of 50 students. Access is on a "first come first serve" basis, allowing students for which the module is compulsory, semi-elective, and, thereafter, elective to enter the course.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 semester
Studiengänge	Agricultural Sciences in the Tropics and Subtropics (Master) 1. Semester, compulsory Biobased Products and Bioenergy (Master) 3. Semester, elective Bioeconomy (Master) 3. Semester, elective (profile: Sustainable biomass production systems) Earth System Science (Master) 3. Semester, elective Earth and Climate System Science (Master) 3. Semester, elective Environmental Protection and Agricultural Food Production (Master) 1. Semester, semi-elective Environmental Science - Soil, Water, and Biodiversity (Master) 1. Semester, elective Environmental Science - Soil, Water, and Biodiversity (Master) 3. Semester, semi-elective Landscape Ecology (Master) 3. Semester, elective Organic Agriculture and Food Systems (Master) 3. Semester, elective
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180

Lern- und Qualifikationsziele	After completion of the module, students are able to explain the principles of ecological agents that regulate the functioning of natural and agricultural ecosystems and to demonstrate the complex biotic interactions in natural landscapes and agro-ecosystems. Further, they are able to explain how to apply ecological concepts and principles to design and manage sustainable agro-ecosystems with improved long-term reliability in agricultural production. During preparation for the exam, while preparing and following up on lectures and while preparing the seminar, students practice self-reliance, time management, personal responsibility and cooperation. They hereby also adopt needful skills in fields, also including communication skills and (foreign) language proficiency. Students learn and practice both critical and analytical thinking and reading of scientific literature in the seminar and their ability to explore a scientific issue. Through the seminar presentation, students improve their oral articulateness and their ability to discuss scientific matters. Finally, students acquire expertise to permit the competent application of technical knowledge and are of use in the solution of practical problems.
empfohlene Vorkenntnisse	-
Anmerkungen	Please register online via ILIAS as the module is restricted to 40 participants. The registration will be open until the end of the first week of the module. A waiting list will be maintained and implemented on the first day of the course. You will receive an electronic confirmation once you have been accepted into the module.
Modulprüfung und Gewichtung	Written exam (70 %)
Studienleistung und Gewichtung	Presentation in groups (20 %) with handout (5 %) and discussion (5 %)
Ecology and Agroecosystems (4906-411)	
Person(en) verantwortlich	Ingo Graß
Lehrform	Vorlesung mit Seminar
SWS	4
Inhalt	• Ecology - outline • Climatically caused diversity of tropical and subtropical ecozones • Agro-ecological zoning system • Plants and environmental factors • Interaction between agriculture and natural ecosystems

	• Principles of ecosystem functions • Interactions in agroecosystems: Species interactions • Agroecosystems of the tropics and subtropics • Wildlife and rangeland ecology • Practical methods in agroecology
Literatur	• Altieri, M.; 1995: Agroecology. Cambridge University Press, Cambridge. • Gliessmann, S.R.; 2000: Agroecology: Ecological processes in sustainable agriculture. CRC Press LLC, USA. • Gliessmann, S.R.; 2000: Field and laboratory investigations in Agroecology. CRC Press LLC, USA. • Krebs, Ch.J.; 2001: Ecology: The Experimental Analysis of Distribution and Abundance, Benjamin Cummings, San Francisco. • Martin, K. und J. Sauerborn; 2006: Agrarökologie, Verlag Eugen Ulmer, Stuttgart. • Ricklefs, R.E. and Miller, G.L.; 2000: Ecology. W.H. Freemann and Company, New York, USA.
Anmerkungen	• º Lectures - to provide fundamental knowledge relevant to agro-ecosystems º Group assignment - to encourage broader interdisciplinary thinking and design in a group context º Examination - the final test of competency • º written exam 70%; seminar presentation 30%

Modul: Economics and Environmental Policy (4902-440)

Modulverantwortung	Kirsten Boysen-Urban
Bezug zu anderen Modulen	Due to its introductory character, this module is a basis for more advanced economic modules such as "Microeconomics", "Agricultural and Food Policy" or "Environmental and Resource Economics".
Teilnahmevoraussetzung	This is an introductory module without any specific prerequisites.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 semester
Studiengänge	Organic Agriculture and Food Systems (Master) 1. Semester, compulsory Environmental Protection and Agricultural Food Production (Master) 1. Semester, compulsory Environmental Science - Soil, Water, and Biodiversity (Master) 3. Semester, semi-elective Agricultural Sciences - Agricultural Economics (Master) 1. Semester, elective Earth and Climate System Science (Master) 3. Semester, elective Bioeconomy (Master) 3. Semester, elective (profile: Bioeconomy Policy Analysis)
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	After completing this module, students are able to explain basic principles and concepts of microeconomics, environmental economics and environmental policy. In addition, students are able to translate these concepts into complex real world situations (market imperfections, policy design, policy distortions, linkage between agriculture and the environment). Students can further comparatively assess different policy options to address environmental problems/resource use. Finally, students are proficient in analysing the limits of economic concepts and their relevance in policy design. During preparation for the exam and while preparing and following up on lectures, students practice time

	management and self-reliance. They learn and practice critical and analytical thinking and learn to apply sound economic reasoning.
empfohlene Vorkenntnisse	-
Anmerkungen	Learning objectives are enhanced by the distribution of exercises and solutions, as well as a voluntary tutorial in order to support students in the application of economic concepts to real world problems.
Modulprüfung und Gewichtung	Written exam (100 %)
Studienleistung und Gewichtung	-
Basic Microeconomics (4902-441)	
Person(en) verantwortlich	Kirsten Boysen-Urban
Lehrform	Vorlesung
SWS	2
Inhalt	This lecture comprises the basic microeconomic concepts of household theory, theory of the firm, and the theory of markets under perfect and imperfect competition, as well as the economics of the public sector (public goods, externalities). These concepts are applied in many examples to the agricultural and food sector of developing and developed economies with a focus on interactions between agriculture and the environment. It will be shown how to apply microeconomic concepts to real world situations and policy challenges. This lecture is enhanced by the distribution of exercises and solutions, as well as a voluntary tutorial in order to support students in the application of microeconomic concepts.
Literatur	The lecture is organized along the microeconomic part of "Principles of Economics" by Gregory Mankiw. The textbook "Economics" by Samuelson/Nordhaus has a similar content. The mathematical concepts used (differential and integral calculus) are well explained in "Fundamental Methods of Mathematical Economics" by Alpha C. Chiang.
Anmerkungen	Basic microeconomics is implemented as in-class lectures. ILIAS will be used as the teaching platform. In the Basic Microeconomics section, you will find teaching material, a forum where questions are answered, and exercise sheets which will be discussed in the tutorial sessions. The lecture and the tutorial material will be updated on a weekly basis as the course proceeds. More information is given in the Syllabus that you can find under the tab „documents“.

Environmental Policy (4902-442)	
Person(en) verantwortlich	Christian Lippert
Lehrform	Vorlesung
SWS	2
Inhalt	In the light of applied economic theory current resource use problems will be analysed. The lecture introduces to basic concepts of environmental and natural resource economics, cost-benefit analysis with respect to environmental resources, the concept of sustainable resource use, as well as to the theory of optimal resource extraction. Moreover, the most important environmental policy instruments will be presented and discussed.
Literatur	• Perman, R., Ma, Y., McGilvray, J., Maddison, D. and M. Common (2011): Natural Resource and Environmental Economics. 4th Edition, Pearson Education.
Anmerkungen	This lecture takes place in the second half of the semester (4 hours per week). A voluntary tutorial is offered.
Exercises to Basic Microeconomics (freiwillig) (4902-443)	
Person(en) verantwortlich	Kirsten Boysen-Urban
Lehrform	Übung
SWS	1
Inhalt	.
Literatur	-
Anmerkungen	-
Exercises to Environmental Policy (freiwillig) (4902-444)	
Person(en) verantwortlich	Christian Lippert
Lehrform	Übung
SWS	1
Inhalt	.
Literatur	-
Anmerkungen	-

Modul: Economics and Management (5205-410)

Modulverantwortung	Franziska Schünemann
Bezug zu anderen Modulen	This module introduces to basic concepts used in Economics and Management required to accomplish the MSc Bioeconomy. It doing so, it (i) complements the semi-elective modules imparting basic knowledge in the agricultural and natural science, and (ii) forms the basis for the more advanced compulsory modules “Internal and External Costs & Benefits of Biobased Products” and “Markets, Innovation and Social Acceptance of Biobased Products”, and for elective modules from the fields of Economics and Management.
Teilnahmevoraussetzung	keine
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Bioeconomy (ab WS 16/17) (Master, PO vom 01.04.2017) 1. Semester, Wahlpflicht Earth & Climate System Science (ab WS21/22) (Master, PO vom 17.07.2021), 1. Semester, Pflicht
Prüfungsdauer (in Minuten)	60
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	Students have a sound knowledge of basic ideas and concepts of economics and corporate finance. They can communicate these ideas and concepts in interdisciplinary teams. They are able to employ methods used in economics and corporate finance to construct solutions to real-world problems that arise the context of organizing the biobased economy. On this basis, they are prepared to follow more advanced Economics and Management courses. Students are able to communicate and to work in interdisciplinary and international teams. They can think analytically and critically and employ quantitative methods to solve economic, business, and social issues. They are able to carve out important and to abstract from less important channels.

empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	Written exam (60 Minutes, 50%) and case study with oral presentation in class (50%)
Studienleistung und Gewichtung	-
Basic Economic Concepts for Bioeconomists (5205-413)	
Person(en) verantwortlich	Franziska Schünemann
Lehrform	Vorlesung mit Übung
SWS	2
Inhalt	This course enables students to understand the operations of value chains in the national and the global context. In order to make the interdependencies of value chains transparent, this course introduces students to the functioning of markets and the role of governments. While the economic concepts we deal with apply more generally, we have a special eye on applications to the bioeconomy. We will use quantitative methods, but economic math tends to be simpler than Math taught to undergraduates at universities. The course paves the ground for subsequent semi-elective Economics modules.
Literatur	To be announced in the lecture.
Anmerkungen	-
Financial Management (5205-414)	
Person(en) verantwortlich	Niklas Lampenius
Lehrform	Vorlesung
SWS	2
Inhalt	The overall objective of the module „Corporate Finance" is to provide a basic understanding of corporate finance and managerial responsibilities. The lectures cover qualitative as well as quantitative aspects of decision making with a focus on sustainability. Contents of the module include: • Capital budgeting • Cash management • Performance management • Risk management (financial as well as operational risks) • Resulting consequences for managerial decision making
Literatur	Stephen Ross, Randolph Westerfield, Jeffrey Jaffe (latest edition), Corporate Finance, Mcgraw-Hill/Irwin.

Anmerkungen	The lectures take place in the first half of the semester (4 hours per week).

Modul: Energy and Water Regime at the Land Surface (3103-500)

Modulverantwortung	Thilo Streck
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	Students should have completed the module Physics of the Earth System and the module Biology of the Earth System and Biodiversity.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 semester
Studiengänge	Earth and Climate System Science (Master) 2. Semester, compulsory Biobased Products and Bioenergy (Master) 2. Semester, elective
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	This interdisciplinary module gives insight into the fundamental properties of and processes at the land surface. This lays the foundation for successfully dealing with numerous problems from the local over the regional to the global scale. After completion of the module, the students have good knowledge of the basic processes in the soil-plant-atmosphere system, which control the water and energy exchange at the land surface, and their representation through the most important governing equations. Students learn to integrate new information with knowledge from the prior modules Physics and Biology of the Earth System. They learn how to apply problem solving strategies independently and in a different situation.
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	Written exam (100%)
Studienleistung und Gewichtung	-

Energy and Water Regime at the Land Surface (3103-501)

Person(en) verantwortlich	Thilo Streck

	Joachim Ingwersen
Lehrform	Vorlesung mit Übung
SWS	4
Inhalt	Lecture: 1) Radiation processes at the land surface (long and shortwave radation, albedo, photosynthetically active radiation) 2) Energy partitioning at the land surface (fluxes of latent and sensible heat, ground heat flux, photosynthesis) 3) Transport of energy and water in soil (1D, 3D; Fourier's law, Richards equation, material functions, infiltration) 4) Landscape hydrology (processes at the watershed scale, linear models, lumped models, semi-distributed models, 3D models) 5) Evapotranspiration (Penman equation) 6) Land surface models (NOAH-MP) 7) Crop models (assimilation, root growth, biological time, stress) 8) Turbulent fluxes (basics, Monin-Obhukov theory) Computer exercises: • Energy partitioning at the land surface • Physical interaction between atmosphere and radiation • Modeling thermal conduction in soil (with Berkeley Madonna) • Modeling water infiltration in soils with Hydrus 2D/3D (with case studies) • Land surface modeling with NOAH-MP • Turbulence and the eddy-covariance technique • Similarity relations including Monin-Obukov Theory
Literatur	• Bonan, G.B. Ecological Climatology: Concepts and Applications. Cambridge University Press, 2008. • Jury, W.A., Horton, R.H. Soil Physics. John Wiley & Sons, 2004. • Hillel, D. Introduction to Environmental Soil Physics: The State and the Transport of Matter and Energy in the Soil-Plant-Atmosphere Continuum. Academic Press, 2003.

	• Campbell, G.S., Norman, J.M. An Introduction to Environmental Biophysics. Springer, 2000.
Anmerkungen	-

Modul: Environmental and Resource Economics (4101-410)

Modulverantwortung	Christian Lippert
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	Knowledge of basic concepts from economic theory (e.g. demand function and its determinants), from investment appraisal (e.g. calculating net present values) and from Environmental Economics (e.g. externalities) as taught in the module Economics and Environmental Policy (4201-440)
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 semester
Studiengänge	Agricultural Sciences - Agricultural Economics (Master) 2. Semester, compulsory Earth and Climate System Science (Master) 2. Semester, elective Bioeconomy (Master) 2. Semester, elective
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	Applying the relevant microeconomic theory students should be enabled to analyse current problems of resource use and agricultural production. Critical analytical thinking; communication and oral presentation; applying economic reasoning.
empfohlene Vorkenntnisse	-
Anmerkungen	Registration of module participants via the ILIAS website of this module ends on Wednesday, April 28th, 2021 at midnight! - Seminar and accompanying computer exercises; seminar papers by the students. – A reader and further material are available at ILIAS.
Modulprüfung und Gewichtung	Written exam (75%)
Studienleistung und Gewichtung	In-class presentation and short seminar paper (25%)
Environmental and Resource Economics (4101-411)	
Person(en) verantwortlich	Christian Lippert
Lehrform	Seminar
SWS	4

Inhalt	Fundamental concepts of Environmental and Natural Resource Economics are introduced and broadly discussed; In the light of applied microeconomic theory current problems of resource use and agricultural production will be analysed; special attention is given to combined economic and ecological models.
Literatur	Perman, R., Yue, M., Common, M., Maddison, D. and J. McGilvray (2011): Natural Resource and Environmental Economics, 4th Edition, Pearson Education.
Anmerkungen	Seminar and accompanying computer exercises; contributions by the students; lecture notes are available at the 'ASta Skriptenverkauf'. Further course material will be uploaded during the course to https://ilias.uni-hohenheim.de.
Tutorial in Environmental and Resource Economics (Freiwillig) (4101-412)	
Person(en) verantwortlich	Christian Lippert
Lehrform	Tutorium
SWS	2
Inhalt	-
Literatur	-
Anmerkungen	-

Modul: Ethical Reflection on Food and Agriculture (4302-420)

Modulverantwortung	Claudia Bieling
Bezug zu anderen Modulen	Global Agri-food Systems (4302-460) and other modules that deal with interdisciplinary aspects of food and agriculture
Teilnahmevoraussetzung	Since the number of participants is limited to 20, students are asked to submit a short letter of motivation to participate in the module; for further info see course description, 4302-421. We will give priority to students that take this module as part of their semi-elective programme and will prioritize Master level students as well as participants of the students' initiative FRESH (given their contribution to developing this module). Criteria for the selection process will be the quality of the motivation letter and, in a second step, the order of submission. Signing up in ILIAS will only be possible after the selection process.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 semester
Studiengänge	Environmental Science - Soil, Water, and Biodiversity (Master) 3. Semester, semi-elective Agribusiness (Master) 3. Semester, elective Agricultural Sciences - Agricultural Economics (Master) 3. Semester, elective Agricultural Sciences - Animal Sciences (Master) 3. Semester, elective Agricultural Sciences - Major: Crop Production Systems (Master) 3. Semester, elective Agricultural Sciences - Soil Science (Master) 3. Semester, elective Agricultural Sciences in the Tropics and Subtropics (Master) 3. Semester, elective Biobased Products and Bioenergy (Master) 3. Semester, elective Bioeconomy (Master) 3. Semester, elective (profile: Innovation and Entrepreneurship | Transforming Food Systems) Crop Sciences - Plant Breeding and Seed Science (Master) 3. Semester, elective Crop Sciences - Plant Nutrition and Protection (Master) 3. Semester, elective Earth and Climate System Science (Master) 3. Semester, elective Earth System Science (Master) 3. Semester, elective

	Environmental Protection and Agricultural Food Production (Master) 3. Semester, elective Landscape Ecology (Master) 3. Semester, elective Organic Agriculture and Food Systems (Master) 3. Semester, elective
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	After completing this module, students have basic knowledge of ethical theory and frameworks for ethical analysis, as well as of their application to the field of contemporary food and agricultural research and practice. Furthermore, course participants are familiar with identifying ethical issues and their underlying moral principles, and with ethical reasoning and evidence-based argumentation with respect to the multi-functionality of agriculture. Drawing on teaching methods that combine theory and on-the-ground experiences from lecturers and guest speakers, this module creates a space to critically discuss current ethical issues related to food and agriculture. Following an interactive didactic approach, students learn to identify the impact of concurrent global challenges on the different members of society (small and large scale farmers, consumers, civil society organizations, industry and retailers, the public sector, and scientists) and the environment, as well as define the roles and responsibilities of the various actors in meeting these challenges. Engaging participants in discussions with lecturers and guest speakers, and comprising a group work assignment that includes independent literature research, classification/prioritization of evidence and information, oral presentations and argumentation in plenary debates, as well as an individual journal exercise, this module enables students to further develop the following soft skills: - communication skills - logical and analytical abilities - critical and analytical reading of scientific literature - evidence-based argumentation

	- teamwork capacity - intercultural competence - scientific journal-based literature research - scientific writing skills - (media-supported) presentation skills - organization and time management skills
empfohlene Vorkenntnisse	-
Anmerkungen	Please note that the number of participants is limited to 20. Therefore, students are asked to submit a short letter of motivation to participate in the module (see above/further info in course description, 4302-421). Signing up in ILIAS will only be possible after the selection process.
Modulprüfung und Gewichtung	Written paper in the form of an individual learner's journal (50 %)
Studienleistung und Gewichtung	Presentation in groups (40 %), contributions to seminar discussions (10 %)
Ethical Reflection on Food and Agriculture (4302-421)	
Person(en) verantwortlich	Claudia Bieling
Lehrform	Seminar mit Übung
SWS	4
Inhalt	The module is broadly structured in two parts: Part I is dedicated to the theoretical foundations of ethical thinking. Under the guidance of an ethicist from the International Center of Ethics in the Sciences and Humanities (IZEW, University of Tübingen), students will become acquainted with basic knowledge of ethical theory and tools for ethical analysis and argumentation, including: - prudence, justice and the good life as principles for ethical assessment - from fact to values and norms: how to build an argument - dealing with non-knowledge. In parallel to the lectures of the first part, students will practice the application of these theories and tools by elaborating case studies (group work) on an ethical

	issue of their choice (e.g. animal welfare, GMOs, biofuels). In Part II, students will further enhance their capacity to identify ethical issues related to the field of food and agriculture and critically reflect on them. For this, guest speakers are invited to share their experiences and perspectives, e.g. as an ethicist working in science or on providing food aid to developing countries. A particular emphasis will be on “solutions” or ways forward for reducing ethical problems and conflicts. As part of this, we will for instance explore the potential of taxation as a means for including ethical concerns in policy as well as alternative economic models that call for a more just economic order.
Literatur	Readings will be provided via ILIAS.
Anmerkungen	Please note that this module is limited to 20 students and can be taken only after applying with a motivation letter! Applications for participation in WS 2023/24 should be submitted from October 2-15, 2023. Please send your letter of motivation to claudia.bieling@uni-hohenheim.de stating the following: 1) Your name 2) Your country of origin 3) Your study programme (and specialization, if applicable) 4) Study programme level (M.Sc./B.Sc./Ph.D.) 5) Statement of motivation: I want to take the course 'Ethical Reflection on Food and Agriculture' because... (around 150 words). The decision about participation will be communicated to applicants by Oct 16, 2023. We will give priority to students that take this module as part of their semi-elective programme, and will prioritize Master level students. Since this module was developed on initiative of the students' group FRESH, FRESH members will be prioritized as well. Please mention if you are an active member of FRESH in your motivation letter. Criteria for the selection process will be the quality of the motivation letter and, in a second step, the order of submission.

Modul: Global Agri-food Systems: Conventional, Organic, and Beyond (4302-460)

Modulverantwortung	Claudia Bieling
Bezug zu anderen Modulen	This module is of particular interest for students who intend to choose the module "Ethical Reflection on Food and Agriculture" and other modules in the field of social sciences.
Teilnahmevoraussetzung	-
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 semester
Studiengänge	Organic Agriculture and Food Systems (Master) 2. Semester, compulsory Earth System Science (Master) 4. Semester, elective Earth and Climate System Science (Master) 4. Semester, elective Bioeconomy (Master) 2. Semester, elective (profile: Sustainable biomass production systems | Transforming food systems within the Bioeconomy)
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	In this course, students are provided with the conceptual tools (most importantly: Food Regime Theory, Food Systems) to understand the sociological bases around which a future world of agriculture, food and broader land use will possibly take shape. After completing this course, students have a comprehensive understanding of agri-food systems and the paradigmatic shifts within. Students are in particular able to specify the diverse motivations and politics that have led farmers, consumers, and policy makers toward (or away from) more sustainable agri-food systems. They are familiar with the geographical, sociological, historical, political, legal, and economic aspects of how and why individuals, groups, and industries make (or are involved in) certain choices about food throughout the food chain (production, processing, trade, consumption). Finally, they are able to explain basic

	concepts and theories related to organic agriculture and sustainability and have an understanding for the complexity of agriculture and food as it relates –among others– to the politics of resources, the environment and social justice. During preparation for the oral exam (video production), while writing their essay (written paper), peer-reviewing an essay of a fellow student and preparing and following up on the seminar, studetns practice self-reliance, time management and team work. During discussions in class, students practice and improve their capability of exploring a scientific issue and of orally presenting an academic argument. With the help of dedicated tutorials, students are further supported with creating an essay plan and essay writing, quoting, referencing, and using academic and non-academic sources (therefore avoiding plagiarism).
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	Written paper (essay 50 %)
Studienleistung und Gewichtung	Video production: 40%, Peer review: 10%
Global Challenges & Local Answers – Approaches for Sustainable Human-Nature-Relations (4302-461)	
Person(en) verantwortlich	Claudia Bieling
Lehrform	Vorlesung
SWS	2
Inhalt	Land Grabbing, soil desertification, precarization of rural livelihoods, and rising global inequality – these are just some examples that show the challenges of today's agriculture and food systems. In this module, we want to undertake a historical and geographical journey to learn more about the roots of these problematics and to discover some 'bright spots' in different regions that show that more sustainable forms of agriculture and land-use are possible. In the first section of the module, students will acquire knowledge on two different theoretical approaches to viewing food systems and their challenges (and solutions) – food regime theory and food systems thinking. Food regime theory offers a historical and global overview of the making of the current agri-food system, as well as the new and emerging social movements that search for more sustainable and just proposals. Parting from theoretical perspectives of political economy and

	political ecology, we analyze the historical phases of food regimes and their colonial embeddedness in the 18th, 19th, and 20th century. Students will gain an inside-view into food regime theory and learn how to connect it with current problematics of the global agri-food system, such as the industrialization of food production and unequal world trade dynamics. Food systems thinking, instead, provides a framework that allows to better describe, understand and analyze complex systems and their non-linear behaviors, fuzzy boundaries and feedback loops. By helping to better understand the relationships between food, humans and the natural environment, food systems theory can help unveil unexpected feedbacks, unsustainable lock-ins, as well as potential leverage points for the sustainable transformation of these systems.
Literatur	-
Anmerkungen	-

Past and future of food systems: perspectives of political economy (4302-462)	
Person(en) verantwortlich	Claudia Bieling
Lehrform	Seminar
SWS	2
Inhalt	After the introduction into Food Regime Theory and Food Systems Thinking, the second section of the module offers insights into social movements that are developing alternative visions to transform the global agri-food system. The focus will be on approaches of Organic Farming, Agroecology, Food Sovereignty, Alternative Food Networks (AFN), and the Food Justice movement. We want to analyse these approaches from a conceptual point of view, considering intersectional and postcolonial perspectives, and discussing ethical dilemmas, such as the tension between institutionalization, commercialization by labelling and strengthening transformative potentials. In the final discussion on Food Futures we will reflect upon questions on what these proposals could mean for transitions towards sustainable development on different scales, regarding global debates (e.g. Sustainable Development Goals), as well as the relevance for our society, region and daily life as students.
Literatur	Course-relevant readings will be made available or uploaded in ILIAS if possible.
Anmerkungen	Because of limited space available (70 students), students must register via ILIAS. A waiting list will be

	available if the number of registrations will exceed expectations.
Tutorial Global Agri-food Systems: Conventional, Organic, and Beyond (freiwillig) (4302-463)	
Person(en) verantwortlich	Claudia Bieling
Lehrform	Tutorium
SWS	2
Inhalt	-
Literatur	-
Anmerkungen	-

Modul: Global Change Issues (3202-420)

Modulverantwortung	Andreas Schweiger
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	Extremely important: you have to be present on the first day of the module in order to be enroled for the module. This is mandatory because of organisational reasons. We will not accept any student for the module who is not present on the first day of the module. General requirements: Ability to think in an interdisciplinary way, background knowledge in natural sciences at least at Bachelor level, basic knowledge and interest in social sciences and economy, readiness for active contribution of knowledge from the students home countries.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 semester
Studiengänge	Biobased Products and Bioenergy (Master) 3. Semester, elective Bioeconomy (Master) 3. Semester, elective (profile: Bioeconomy Policy Analysis) Earth and Climate System Science (Master) 3. Semester, elective Environmental Science - Soil, Water, and Biodiversity (Master) 1. or 3. Semester, elective Environmental Science - Soil, Water, and Biodiversity (Master) 3. Semester, semi-elective in Specialization "Environmental Impacts" Environmental Science - Soil, Water, and Biodiversity (Master) 3. Semester, semi-elective in Specialization "Climate Change" Environmental Protection and Agricultural Food Production (Master) 3. Semester, semi-elective Landscape Ecology (Master) 3. Semester, elective
Prüfungsdauer (in Minuten)	90
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The aim of the module is to give a solid understanding of global change including global climate change, its impacts on species and

ecosystems and ecological services, and the consequences for human society. This module has a natural science focus but covers societal and economic aspects of global change including mitigation and adaptation strategies as well as current approaches in international treaties.

After completing the course the student will:

- know the drivers of global change and global climate change and distinguish between natural and human impact
- understand the perturbations of the global carbon, nitrogen, and water cycles
- know and understand the major threats to ecosystems and ecological services and the potential impacts on the human society.
- understand the effects of climate change on natural and anthropogenic (mainly agricultural) ecosystems including the most important feedbacks between ecosystem structure and processes and climatic conditions
- be familiar with international treaties to combat climate change and understand mitigation and adaptation strategies to climate change
- know methodological tools to investigate global change and its ecological impacts and feedbacks

The student will be furthermore able to:

- combine knowledge from different disciplines of natural science to analyze the extent and socio-ecological consequences of climate change
- think across scales both in time and space to evaluate global change issues
- judge about the severity of climate change and its effects compared to other drivers of ecosystem functionality
- perform experimental research on ecological effects of climate change with a focus on plants
- acquire, evaluate and summarize information from scientific literature and present this information in scientific presentations.

	The structure of the module provides the following competences: • The students will be able to discuss ecological, social, political and economic aspects of global change. • They are furthermore able to develop and communicate mitigation and adaptation strategies to combat the socio-ecological consequences global change and foster sustainable development. • The students will be able to co-operate and to work independently. • They will be able to evaluate critically data and model outputs on emissions, regulatory measures and treaties and suggest improvements. • The students will furthermore acquire intercultural competence by working in groups with international students.
empfohlene Vorkenntnisse	-
Anmerkungen	The module consists of a lecture (Introduction to Global Change, 2SWS), a seminar (Emerging Topics in Global Change Research, 1 SWS) and a practical part (Experiments on Global Change, 1 SWS). The practical part will be conducted in Hohenheim according to the applicable safety regulations. The number of participants is limited to a maximum of 15. Participants will be selected with regard to the study program and the number of semesters. Enrolment will take place via ILIAS. Information on how to access the lectures/seminar will be provided via ILIAS in October.
Modulprüfung und Gewichtung	Written exam (70%)
Studienleistung und Gewichtung	Presentation (15%) Exercise (15%)
Global Change Issues (3202-421)	
Person(en) verantwortlich	Andreas Fangmeier Petra Högy
Lehrform	Vorlesung mit Seminar und Praktikum
SWS	4
Inhalt	Introduction to Global Change Introduction to Global Change is a lecture introducing to the students the most important knowledge and current research on global change with a special focus on global climate change.

Contents of the lectures cover:

- Human population and land-use change
- Greenhouse gas emissions
- The concept of radiative forcing and global warming
- Sea level rise
- Global carbon, water and nitrogen cycling and future projections
- Effects on natural and seminatural ecosystems
- Effects on agriculture
- Health impacts
- Mitigation options
- International legislation
- Emission trading

Emerging Topics in Global Change Research

This seminar is thought to complement the lecture "Introduction to Global Change" with some most recent findings from current publications in the scientific literature and will cover current challenges and emerging topics in global change research. The actual content will vary from year to year but may cover issues such as the latest findings on disturbance of the global carbon cycle and its implications for climate, ecological footprints, state of international negotiations, case studies on climate change effects on selected ecosystems, ecosystem services, habitats etc.

The students will prepare a powerpoint presentation on a selected topic, they will present and discuss it and get feed-back not only on the scientific content but also on the didactics of their presentation.
Experiments on Global Change

In this practical part of the module the students will plan and conduct their own greenhouse experiment (Hohenheim) in which one of the most important resources to plant growth - water – will be manipulated. Water shortage is one of the major expected side effects of climate change and therefore represents a scientifically sound and relevant example on how to study climate change effects on plants. The students will analyze the response of C3 and C4 species to water shortage and learn about water cycling, water use efficiency

	and physiological adaptation of vegetation to resource deficiency. Furthermore, they will conduct ecophysiological investigations (leaf gas exchange measurements) with increasing atmospheric CO2 concentrations to evaluate primary plant responses to elevated CO2. The students will prepare a powerpoint presentation on the results of their experiments and discuss it and get feed-back not only on the scientific content but also on the didactics of their presentation.
Literatur	Introduction to Global Change Literature on global change is numerous and almost immediately outdated when recommendations are written down somewhere. Nevertheless, as basic literature for understanding the current state of the art in science and recommendations to policy makers the latest reports of the IPCC are recommended (download at http://ipcc.ch/). Further literature is provided on the ILIAS e-learning platform Emerging Topics in Global Change Research Ever changing and updated; students are assisted to find relevant literature and other sources; sources will be made available via the ILIAS e-learning platform.
Anmerkungen	-

Modul: Introduction to Machine Learning in Python (4407-480)

Modulverantwortung	Christian Krupitzer Anthony Stein
Bezug zu anderen Modulen	The module provides basic knowledge on machine learning that well prepare the students for participation in subsequent AI modules, i.e., 4407-440 "Einführung in die Künstliche Intelligenz", 4407-470 "Artificial Intelligence for Agriculture", 4407-490 "Bildanalyse mit Deep Learning" or 4407-810 "Machine Learning Reading Club".
Teilnahmevoraussetzung	-
Lehrsprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 Semester
Studiengänge	Agrarwissenschaften - Agrartechnik (Master), 2. Semester, semi-elective All Master's programs of the Faculty of Agricultural and Natural Sciences, 2. semester, elective Information Systems (Master), elective Bioeconomy (Master), 2. Semester, elective (Profil: Data Science and Artificial Intelligence)
Prüfungsdauer (in Minuten)	90
Präsenzstudium (in Stunden)	0
Selbststudium (in Stunden)	225
Arbeitsaufwand (in Stunden)	225
Lern- und Qualifikationsziele	After completing this module, students are able to critically assess the performance of different machine learning approaches and to choose the best approach for a specific use case. Therefore, this module will provide essential theoretical knowledge of the foundations of programming in Python and machine learning algorithms and approaches.Further, students acquire practically-applicable knowledge how to apply machine learning to solve real world problems. The online format, regular assignments as well as the self-study character of the module supports the students' organizational skills and trains their ability to work independently. Further, the module supports analytical thinking, i.e., how to structure a problem and find appropriate solutions to it by means

	of machine learning. Since the course materials and the teaching language are completely in English, the students further train their foreign language skills.
empfohlene Vorkenntnisse	Module 4407-480 is a Master's program module, but can already be taken as an elective in Bachelor's degree programs in agricultural sciences. No prior programming skills are assumed. The necessary basic concepts of Python programming are taught in the first third of the course. In order to prepare for later AI modules in the Master's programs, it is recommended to take this course already during the specialization phase in the Bachelor's programs.
Anmerkungen	The maximum number of participants is limited to a semester-specific amount. In case the threshold is exceeded, a waiting list will be maintained.
Modulprüfung und Gewichtung	Computer-based online exam (50%)
Studienleistung und Gewichtung	Integrated online quizzes and programming assignments to be solved individually by the students (50%)
Introduction to Machine Learning in Python (4407-481)	
Person(en) verantwortlich	Anthony Stein Christian Krupitzer
Lehrform	E-Learning
SWS	5
Inhalt	-
Literatur	-
Anmerkungen	-

Modul: Land Use Economics (4904-430)

Modulverantwortung	Thomas Berger
Bezug zu anderen Modulen	This module advances the knowledge in land-use economics and the essential steps required in the modeling process (conceptual modeling, model selection, parameterization and validation). Hands-on computer exercises address various aspects of agricultural land-use systems with emphasis on designing and analyzing simulation experiments for uncertainty and sensitivity assessments.
Teilnahmevoraussetzung	Basic knowledge of Mathematical Programming (Textbook: Ragsdale, C.T., 2004. Spreadsheet Modeling & Decision Analysis, Ch. 1-4)
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1. half of semester
Studiengänge	Earth System Science (Master) 3. Semester, compulsory Bioeconomy (Master) 3. Semester, elective (profile: Bioeconomy Policy Analysis and profile Sustainability Assessement) Earth and Climate System Science (Master) 3. Semester, elective Agricultural Sciences - Agricultural Economics (Master) 3. Semester, semi-elective
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	Students understand fundamental concepts of land use economics. They can model land use decision problems at various spatial scales. They have gained insights into advanced techniques such as bio-economic modeling and multi-agent systems. By developing their own simulation models, students apply analytical thinking and aquire various scientific skills (e.g., data handling, processing and analysis, oral presentation).
empfohlene Vorkenntnisse	Contents of Farm-System Modeling (4904-460)
Anmerkungen	Laptop required for computer exercises in class
Modulprüfung und Gewichtung	Written exam (100%)
Studienleistung und Gewichtung	-

Land Use Economics (4904-431)	
Person(en) verantwortlich	Thomas Berger
Lehrform	Vorlesung mit Übung
SWS	4
Inhalt	• Land-use economics: basic concepts and research questions • Land-use modeling: model classes and cases of application • Irrigation as a special land-use problem • Land-use modeling at watershed level (case study) • Land-use modeling with CA and MAS
Literatur	-
Anmerkungen	-

Modul: Lecture Series Earth System Science (1201-550)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	None
Teilnahmevoraussetzung	None
Lehrsprache	englisch
ECTS	2
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 1. Semester, Pflicht Earth and Climate System Science (Master, PO vom 01.10.2017) 1. Semester, Pflicht
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	28
Selbststudium (in Stunden)	32
Arbeitsaufwand (in Stunden)	60
Lern- und Qualifikationsziele	The students get a general idea of the key aspects of Earth System Science as well as the definition and the research approach of system science. The interaction of the compartments of the Earth system is demonstrated by a series of lectures focusing on different aspects such as climate change, land use, vegetation and biogeochemical cycles. The contents of the lecture series is set up in each semester according to brand-new topics, e.g. extracted from the media. The predictability of Earth system pro-cesses and the chaotic nature of weather and climate are discussed as well.
empfohlene Vorkenntnisse	None
Anmerkungen	-
Modulprüfung und Gewichtung	Written examination
Studienleistung und Gewichtung	None
Lecture Series Earth System Science (1201-551)	
Person(en) verantwortlich	Volker Wulfmeyer
Lehrform	Ringvorlesung
SWS	2
Inhalt	- Compartments of the Earth System - Condition and interactions of components of the energy, water, and matter cycles across the compartments

	- Impact of human being to the Earth system, the anthroposphere - System theory - nonlinear coupled systems and chaotic systems Furthermore the students meet in person the representatives of the profession Earth System Science at the University of Hohenheim. The students meet the experts of different aspects in Earth System Science at the University.
Literatur	-
Anmerkungen	Steffen et al.: "Global Change and the Earth System - A Planet under Pressure", Springer, ISBN 3-540-40800-2

Modul: Master-Thesis (1200-500)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	Successful completion of modules in the amount of 75 credits.
Lehrsprache	englisch
ECTS	30
Angebotshäufigkeit	jedes Semester
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 4. Semester, Pflicht Earth and Climate System Science (Master, PO vom 01.10.2017) 4. Semester, Pflicht
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	-
Selbststudium (in Stunden)	-
Arbeitsaufwand (in Stunden)	900
Lern- und Qualifikationsziele	After completion of the master thesis the students understand sub-components of the Earth system by inter- or transdisciplinary research, e.g., from atmospheric, agricultural, economic or social sciences. The studied interactions and feedbacks in these components either by measurements and their analyses, coupled modeling or data assimilation or combinations of these. They are able to understand the key processes in these systems and their interactions. They are able to present and to discuss their results at scientific conferences and in the public. - System analysis - System observations by synergies of instruments - System modeling - Competence to present their work in a comprehensive and concise manner.
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	Master's thesis
Studienleistung und Gewichtung	-

Modul: Mathematics and Computational Sciences of the Earth System (1102-400)

Modulverantwortung	Georg Zimmermann
Bezug zu anderen Modulen	Mathematical foundation for Module 1102-410.
Teilnahmevoraussetzung	Solid basic knowledge of mathematics as covered by a typical B.Sc.-program
Lehrsprache	englisch
ECTS	4
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Earth and Climate System Science (Master, PO vom 01.10.2017) 1. Semester, Pflicht Food Biotechnology (Master, PO vom 01.10.2016) 2. Semester, Wahl Food Science and Engineering (Master, PO vom 01.10.2013) 2. Semester, Wahl
Prüfungsdauer (in Minuten)	90
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	64
Arbeitsaufwand (in Stunden)	120
Lern- und Qualifikationsziele	Students who complete this module will obtain competency in the use of mathematical tools required for analysis and linear algebra, which are necessary to solve general and partial differential equations. Furthermore, students will be able to write simple computer programmes to solve related mathematical problems and be able to analyse data.
empfohlene Vorkenntnisse	Solid foundational knowledge of Mathematics at Bachelor level of a study program in science.
Anmerkungen	Number of participants: unlimited
Modulprüfung und Gewichtung	Written exam (100%)
Studienleistung und Gewichtung	50 % credit on the homework assignments
Applied Mathematics for Earth and Climate System Science (1102-401)	
Person(en) verantwortlich	Georg Zimmermann
Lehrform	Vorlesung
SWS	2
Inhalt	1) Complex numbers 2) Linear algebra:

	matrices and linear mappings, eigenvalues and eigenvectors, quadratic forms and definiteness. 3) Differentiation: ordinary and partial derivatives, gradient, divergence and curl, Laplacian operator. 4) Integration: indefinite and definite integrals, curves and line integrals, conservative vector fields, surfaces and surface integrals, integral theorems by Gauß and Stokes.
Literatur	Any standard book on mathematics for physicists or engineers. in English: basic (undergraduate level): M.L. Boas, Mathematical Methods in the Physical Sciences advanced (graduate level): G. B. Arfken, Mathematical Methods for Physicists in German: H. Fischer / H. Kaul, Mathematik für Physiker 1 & 2
Anmerkungen	-
Computer Exercises for Earth and Climate System Science (1102-402)	
Person(en) verantwortlich	Georg Zimmermann
Lehrform	Übung
SWS	2
Inhalt	Exercises to the topics of Applied Mathematics for Earth and Climate System Science using the programming environment Mathematica. Analysis and visualization of earth system observations and climate data using Mathematica.
Literatur	-
Anmerkungen	-

Modul: Mathematics and Computational Sciences of the Earth System II (1102-410)

Modulverantwortung	Georg Zimmermann
Bezug zu anderen Modulen	Continuation of Module 1102-400.
Teilnahmevoraussetzung	Successful completion of module 1102-400.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 Semester
Studiengänge	Food Biotechnology (Master, PO vom 01.10.2016) 2. Semester, Wahl Food Science and Engineering (Master, PO vom 01.10.2013) 2. Semester, Wahl Earth and Climate System Science (Master, PO vom 01.10.2017) 2. Semester, Wahl
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The aim of this module is that the students can recognise ordinary and partial differential equations as such. They shall also recognise some special types of differential equations. They know how to solve certain types of differential equations, some explicitly, others numerically. They can recognise autonomous systems, find stationary solutions and determine their stability properties. The aim of this module is for students to understand differential equations in the sense that they recognise which effects are modelled by each term. They know stability properties and how to determine them.
empfohlene Vorkenntnisse	Successful participation in module 1102-400
Anmerkungen	Maximum number of participants: - Registration: in consultation with the lecturer at the beginning of the semester
Modulprüfung und Gewichtung	Exam (100%)
Studienleistung und Gewichtung	Submission of exercises (at least 50% of the total score must be achieved)
Mathematics and Computational Sciences of the Earth System II (1102-411)	

Person(en) verantwortlich	Georg Zimmermann
Lehrform	Vorlesung mit Übung
SWS	4
Inhalt	Ordinary differential equations: difference versus differential equations, solution methods, autonomous systems and the stability of their stationary solutions, existence and uniqueness of solutions; numerical methods. Partial differential equations: quasilinear PDEs, wave equation, heat equation; numerical methods.
Literatur	Lecture notes provided by the lecturer. Additional, if so desired: Any standard book on mathematics for physicists or engineers. Examples: in English: basic (undergraduate level): M.L. Boas, Mathematical Methods in the Physical Sciences advanced (graduate level): G. B. Arfken, Mathematical Methods for Physicists in German: H. Fischer / H. Kaul, Mathematik für Physiker 1 & 2
Anmerkungen	-

Modul: Measurement, Modeling and Data Assimilation I (1201-520)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	Alle Pflichtmodule des ersten Semesters.
Teilnahmevoraussetzung	Recommended requirements: modules of the first semester, good computer skills, e.g. word processing and spreadsheets.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 1. Semester, Pflicht Earth and Climate System Science (Master, PO vom 01.10.2017) 2. Semester, Pflicht Promotionsstudiengang Naturwissenschaften (Promotionsstudiengänge, PO vom 14.02.2015) 1. Semester, Wahl
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	84
Selbststudium (in Stunden)	96
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The students can install and operate observing systems in the field. They know how to archive, visualize and analyze the data and are aware of the importance of observations for driving, ini-tialization, calibration and validation of numerical models. In addition, practical work with the Weather Research and Forecasting model (WRF) will be carried out and the students learn how to visualize, interpret and document their results.
empfohlene Vorkenntnisse	Keine.
Anmerkungen	Independent study consists of 2 hours of preparation and review for each session of the lecture, 1 hour review per session of the Exercise and 5 days for the independent composition of a written report on the field course.
Modulprüfung und Gewichtung	Written exam
Studienleistung und Gewichtung	Active participation in the practical parts of the module and the lectures.
Measurement, Modeling and Data Assimilation I, Lecture (1201-521)	
Person(en) verantwortlich	Andreas Behrendt

	Volker Wulfmeyer Hans-Dieter Wizemann
Lehrform	Vorlesung
SWS	4
Inhalt	The lecture introduces several observing systems ranging from meteorological in-situ sensors for the different variables, instruments applied in soil sciences and biology, eddy-covariance measurements as well as remote sensing techniques. Apart from the description of the instruments itself, methods to analyze the collected data are introduced. Following the instrumental part, the meteorological workstation NinJo is introduced. It was developed to facilitate the work with huge data sets in operational meteorological forecasting. Then, the transfer to modeling is carried out with the introduction of data analysis techniques to convert point measurements to spatially resolved information. The third part of the lecture introduces the basic concept of mod-eling. What models are available? How important are observa-tions for modeling? In which areas are models applied, what their performance is and what methods are applied to judge the model performance.
Literatur	-
Anmerkungen	-
Measurement, Modeling and Data Assimilation I, Exercise (1201-522)	
Person(en) verantwortlich	Andreas Behrendt Volker Wulfmeyer
Lehrform	Übung
SWS	2
Inhalt	In the exercise sessions, the students will solve problems adjust-ed to the subjects they learned in the lectures. These range from arithmetic problems to the analysis and visualization of observed data and model results.
Literatur	-
Anmerkungen	-
Measurement, Modeling and Data Assimilation I, Practical (1201-523)	
Person(en) verantwortlich	Andreas Behrendt Volker Wulfmeyer
Lehrform	Praktikum

SWS	2
Inhalt	In the practical sessions, the students learn how to set up instru-ments in the field and how the observational data is gathered, archived and analyzed. Here, they work with data from different instruments introduced during the lecture. After the introduction of basic concepts of modeling, practical work is done to set up and run the Weather Research and Fore-casting model (WRF) on a Linux PC including the analysis and visualization of the results.
Literatur	-
Anmerkungen	-

Modul: Measurement, Modeling and Data Assimilation II (1201-530)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	The modules "Mathematics and Computational Sciences" and "Weather and Climate Physics" in the first semester and "Measurements, Modelling and Data Assimilation I" in the second semester must have been accomplished. This module builds on part 1.
Teilnahmevoraussetzung	Recommended requirements: Participation in the first module “Measurement, Modeling, Data Assimilation I, Computer practice (e.g. word processing, spreadsheet, basic knowledge with Linux)
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 3. Semester, Wahl Earth and Climate System Science (Master, PO vom 01.10.2017) 3. Semester, Wahl
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The students learn the basics of model development, programming and data assimilation. They will understand the fundamentals of microeconomics for the representation of production processes, are able to solve first practical decision problems with the aid of spreadsheet programs and solvers, and can discuss their results. In addition, they will deepen their knowledge about models for plant development, weather and climate and are able to critically judge their performances with the aid of observational data. Furthermore, a theoretical introduction into data assimilation techniques is given. With this knowledge, competence to estimate the future development of the earth system is developed. Furthermore, the students are capable to independently analyze and solve problems related to the earth system.
empfohlene Vorkenntnisse	In-depth knowledge of physics and mathematics, interest in simulating the atmosphere with numerical

	models on different scales. Familiarity with the Linux operating system and initial experience with programming languages.
Anmerkungen	Maximum number of participants: 10 Application to participate in the module: End of summer term until beginning of winter term using the ILIAS system.
Modulprüfung und Gewichtung	Written exam
Studienleistung und Gewichtung	Active participation in the practical parts of the module and the lectures
Measurement, Modeling and Data Assimilation II (1201-531)	
Person(en) verantwortlich	Volker Wulfmeyer
Lehrform	Vorlesung
SWS	2
Inhalt	The students learn the basics of model development, program-ming and data assimilation. They deepen their knowledge about models for plant development, weather and climate and are able to critically judge their performances with the aid of observational data. Furthermore, a theoretical introduction into data assimilation techniques is given.
Literatur	Kalnay, E.: Atmospheric Modeling, Data Assimilation and Predictability, Cambridge University Press, 2003. Evensen, G.: Data Assimilation, Springer, 2nd edition 2009
Anmerkungen	-
Measurement, Modelling and Data Assimilation II, Exercise (1201-532)	
Person(en) verantwortlich	Andreas Behrendt Volker Wulfmeyer
Lehrform	Übung
SWS	2
Inhalt	In the practical part, the students deepen their knowledge gained during the lecture with modeling and data assimilation exercises. As in the first part of the module, the Weather Research and Forecasting model (WRF) is applied.
Literatur	Kalnay, E.: Atmospheric Modeling, Data Assimilation and Predictability, Cambridge University Press, 2003. Evensen, G.: Data Assimilation, Springer, 2nd edition 2009
Anmerkungen	-

Modul: Microbiological Safety within the Feed and Food Production Chain (4605-430)

Modulverantwortung	Ludwig Hölzle
Bezug zu anderen Modulen	The knowledge gained by this basic module may be completed in several other more specific modules, especially 4602-430 "Project in advanced Environmental- and Animal Hygiene", 4602-440 "Laboratory Course in Advanced Environmental- and Animal Hygiene".
Teilnahmevoraussetzung	Students shall have basic knowledge in the biochemistry of carbohydrates, fats and proteins as well as in biology and genetics. For better preparation of the students, an introductory lecture is given for those participants who like to fresh up their knowledge before the module starts.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Environmental Protection and Agricultural Food Production (Master) 1. Semester, compulsory Earth and Climate System Science (Master) 3. Semester, elective Landscape Ecology (Master) 3. Semester, elective Environmental Science - Soil, Water, and Biodiversity (Master) 1. or 3. Semester, elective Agricultural Sciences - Animal Sciences (Master) 3. Semester, elective Agricultural Sciences in the Tropics and Subtropics (Master) 3. Semester, elective Bioeconomy (Master), 3. Semester, elective (Profil: Transforming Food Systems within the Bioeconomy)
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	Students are able to understand and analyse the complex ecologic and microbial systems in soil, air and water as potential epidemiological niches for plant and animal pathogens and zoonotic agents. In addition, students are enabled to perform hygienic risk assessment during microbiocidal biotechnical processes, i.e. composting, anaerobic treatment and

	waste water treatment. In the group with international students they experience the cultural differences in risk assessment and can develop their intercultural competence in this module. Based on these skills and knowledge absolvents are capable to play an important role as advisors in international consultant teams regarding the hygiene of biotechnical processes. critical, analytical thinking , (foreign) language skills
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	oral exam (100 %)
Studienleistung und Gewichtung	-
Microbiological Safety within the Feed and Food Production Chain (4605-431)	
Person(en) verantwortlich	Wolfgang Beyer Ludwig Hölzle
Lehrform	Vorlesung
SWS	4
Inhalt	Principles of microbial morphology and physiology (bacteria, fungi, viruses), life cycles of parasites, microbiology and parasitology of vertebrates, plants, soils, water, and air; survival and inactivation of organisms; techniques for isolation and identification of organisms from soil, water and air. A set of questions will help in exam preparation.
Literatur	• Brock : Biology of Microorganisms, Pearson Education International, Upper Saddle River,NJ07458 • Hurst, Crawford, Knudsen, McInerney, Stetzenbach: Manual of Environmental Microbiology, ASM Press, Washington, DC • Bush, Fernandez, Esch, Seed: Parasitism, Cambridge University Press, Cambridge
Anmerkungen	-

Modul: Molecular Biology and Data Analysis in Microbiology (4613-410)

Modulverantwortung	Amélia Camarinha da Silva
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	-
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Agricultural Sciences - Animal Sciences (Master) 3. Semester, semi-elective Agricultural Sciences - Agricultural Engineering (Master) 3. Semester, elective Agricultural Sciences - Soil Science (Master) 3. Semester, semi-elective Agricultural Sciences - Crop Production Systems (Master) 3. Semester, elective Crop Sciences (Master) 3. Semester, elective Earth and Climate System Science (Master) 3. Semester, elective Environmental Science - Soil, Water, and Biodiversity (Master) 3. Semester, semi-elective
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	a) Plan, execute and interpret experiments; b) Learn routine techniques in molecular biology (PCR, gel electrophoresis of agarose, sequencing) c) Familiarization with databases of genomic information and bioinformatics tools (Blast, RDP, Mothur, QIIME, etc.) to characterize microbial communities d) Improve oral and written communication and e) Critical thinking. At the end of the module the students will understand and explain the core concepts of molecular biology. They will learn about the most up to date genomic

	methods used in microbiome characterization and to apply bioinformatic programs to perform microbiome data analysis. Through the lectures and exam preparation the students learn how to acquire and structure knowledge and information and to have a critical and analytical thinking. During the practical course the students will have the opportunity to implement what they have learned in the lectures, strength their knowledge, to work independently in the laboratory and in the computer with specific software, to improve their skills in critical thinking and problem solving. The written skills will be trained in the extended abstract and their oral presentation skills in the oral presentation of a specific scientific publication.
empfohlene Vorkenntnisse	-
Anmerkungen	Registration of the participation is required and has to be made at ILIAS. Participants have to choose one of the given topics for the seminar at the first lecture date. The list of topics will be posted at ILIAS before.
Modulprüfung und Gewichtung	Written exam (50%)
Studienleistung und Gewichtung	Seminar presentation and extended abstract (50%)
Molecular Biology and Data Analysis in Microbiology (4613-411)	
Person(en) verantwortlich	Amélia Camarinha da Silva
Lehrform	Vorlesung mit Seminar und Praktikum
SWS	4
Inhalt	At the end of the module the students will understand and explain the core concepts of molecular biology. They will learn about the most up to date genomic methods used in microbiome characterization. In the practical course students will learn molecular biology techniques (PCR, gel electrophoresis of agarose, sequencing) and work with bioinformatic programs (Blast, RDP, Primer3, Mothur, QIIME, etc.) to characterize microbial communities.
Literatur	-
Anmerkungen	Registration of the participation is required and has to be made via ILIAS.

Modul: Natural Resource Use and Conservation in the Tropics and Subtropics (4907-410)

Modulverantwortung	Folkard Asch
Bezug zu anderen Modulen	This module is directly linked to all other compulsory modules in AgriTropics.
Teilnahmevoraussetzung	.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Agricultural Sciences in the Tropics and Subtropics (Master) 1. Semester, compulsory Bioeconomy (Master) 3. Semester, elective (profile: Sustainable biomass production systems) Earth and Climate System Science (Master) 3. Semester, elective Environmental Protection and Agricultural Food Production (Master) 3. Semester, semi-elective
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	Students acquire basic knowledge on resource use, requirements, and conservation as linked to tropical agricultural production. They learn to define and evaluate the different abiotic and biotic resources and their relevance for sustainable agricultural production systems. The are able to recognize and define disciplinary and systemic interactions of resource use and conservation and can apply this knowledge in concepts of sustainable agricultural production.
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	Written exam (100 %)
Studienleistung und Gewichtung	-

Natural Resource Use and Conservation in the Tropics and Subtropics (4907-411)

Person(en) verantwortlich	Folkard Asch Uta Dickhöfer Bettina Haussmann
Lehrform	Vorlesung
SWS	4

Inhalt	1) Introduction - module requirements - module links within the compulsory moduls - Ilias - exam mode and requirements - expectations 2) Systems thinking - multidisciplinary approaches - Resources - functions - links between resources - concepts of use and conservation 3) Weather - Climate - global circulation - wind systems - ocean currents - global energy distribution - precipitation patterns - agro-ecolgical zoning - agri-ecological zones -examples 4) Precipitation patterns - agro-ecological zoning - agri-ecological zones -definitions- Length of growing period - Köppen-Geiger-vegetation zones -examples 5) Global water cycle - precipitation - evaporation - transpiration - run-off - surface pools - kondesation - movement - immobilisation - water table recharge - drainage - percolation 6) Water as a resource - global water issues- virtual water - Green -Blue -Grey - Water Concepts - rain water harvesting - field water management - water and soil -soil degradation and withering -tropical soils = problem soils 7) General definitions, soil functions and global soil degradation 8) Soil description and systematics 9) Soil diversity at variable scales 10) Problem soils and their management 11) Exercise: Calculation of site characteristics 12) Soil management in Sahelian subsistence farming systems 13) Major land usetypes of the tropics and subtropics and ecosystems services 14) Crop production systems, crop management and resource use in the tropics and subtopics: Potentials and constriants 15) Land use change, LUC assessement: tools and approaches 16) Matter flows in landscapes, interconnectivity of landscapes 17) Land degradation: types, extent, human impact, consequences and mitigation options at landscape level 18) Global diversity of vascular plants, Role of the tropics and subtopics: origin of most food crops, Agricultural threats to biodiversity 19) Natural resource use in tropical livestock systems: - System classifications - Resource use by livestock - efficiency of nutrient and water conversion - examples

	20) Tropical feed resources: - Feed evaluation systems - Nutritional value of tropical feed resources 21) Tropical feed resources: - Nutritional value of tropical feed resources (cont.) - Feed management and conservation - examples of livestock feeding in different production systems 22) Grassland-based livestock production: - Grassland ecotypes - Spatio-temporal availability in resource availability - Pastoral livestock systems 23) Grassland-based livestock production: - Grassland degradation processes - 24) Grassland-based livestock production: Rangeland concepts - Management strategies 25) Plant Genetic Resources (PGR), Roles and functions of crop and varietal diversity in the production system (including linkage with nutrition), PGR conservation (ex situ, in situ - farmer management of diversity), Use of PGR : legal framework (CBD, ITPGRFA, SMTA, benefit sharing) 26) Use of PGR and crop improvement targeting sustainable production systems and sustainable use of natural resources (P, N efficiency) 27) Use of PGR and crop improvement to cope with climate variability and change 28) Use and breeding of minor crops
Literatur	-
Anmerkungen	-

Modul: Plant and Crop Modeling (3103-410)

Modulverantwortung	Thilo Streck
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	Basic knowledge of mathematics will be helpful (esp. calculus; ordinary differential equations).
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Agricultural Sciences - Soil Science (Master) 3. Semester, elective Bioeconomy (Master) 3. Semester, elective (profile: Sustainable biomass production systems) Crop Sciences - Plant Nutrition and Protection (Master) 3. Semester, elective Earth and Climate System Science (Master) 3. Semester, elective Environmental Science - Soil, Water, and Biodiversity (Master) 3. Semester, semi-elective Environmental Protection and Agricultural Food Production (Master) 3. Semester, semi-elective in Specialization "Soil Resources and Land Use"
Prüfungsdauer (in Minuten)	30
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	After successfully completing the module, students understand the important role of models of plant and crop growth in many disciplines (e.g. agricultural sciences, agricultural economics, bioeconomics, hydrology, earth system science, environmental physics and meteorology). They can specify the general concepts currently used in modelling the processes determining plant and crop growth. Students have a good understanding of the concepts and modelling approaches required for the development of crop growth models appropriate for various environmental situations from the local to the regional scale. They are finally able to work with and further develop basic plant growth models which integrate knowledge from different disciplines at the interface between biogeophysics, plant physiology and agricultural sciences, in particular models of phenological development, biological switches,

	light transmission in canopies, leaf gas exchange, photosynthesis, growth and respiration, transport processes and assimilate partitioning in plants and water and nutrient uptake by plants. Students are ultimately proficient in respective biochemical approaches and plant morphology. Students enhance their organizational skills, self-reliance, time management and team work abilities while preparing and following up on lectures and during the exercises and while preparing for the exam. They learn and practice critical and analytical thinking in the lectures and the exercises, improve their ability of integrating knowledge from different disciplines, and gain experience in approaching complex scientific subjects.
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	Oral exam (100 %)
Studienleistung und Gewichtung	-
Plant and Crop Modeling (3103-411)	
Person(en) verantwortlich	Thilo Streck
Lehrform	Vorlesung mit Übung
SWS	4
Inhalt	.
Literatur	-
Anmerkungen	-

Modul: Plant Quality (3408-460)

Modulverantwortung	Uwe Ludewig
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	-
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Crop Sciences - Plant Nutrition and Protection (Master) 3. Semester, elective Bioeconomy (Master) 3. Semester, elective Earth and Climate System Science (Master) 3. Semester, elective Bioeconomy (Master) 3. Semester, elective
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	After successfully completing the module, students are able to describe the main requirements for the external appearance and physical composition of plant products (food, feed and other biobased products) from the perspective of the processor, marketer, consumer and legislator. They can specify means of influencing the quality by plant mineral nutrition (external quality, content and storage of value-adding ingredients; suppression of unwanted plant compounds) and can evaluate the possibilities of influencing the quality by mineral nutrition in comparison with other means, such as breeding (eg. genetically modified crops) and plant cultivation strategies. Students are familiar with quality concepts and the quality of the product beyond (eg. production quality). Students acquire these abilities in the lecture (2 SWS). In the accompanying seminar, students present and discuss original work from the literature and current aspects of plant quality in short lectures. A one-day excursion to LUFA Speyer gives an insight into the practice of the official quality control of agricultural products.

	During preparation for the exam, while preparing and following up on lectures and while preparing the seminar, students enhance their organizational skills, self-reliance, time management and team work. They learn and practice both critical and analytical thinking and reading of scientific literature in the seminar, while generally improving their ability of exploring a scientific subject. While preparing the seminar, students improve their scientific articulateness and further improve their oral communication skills, presentation techniques and discourse capacities through presenting their work.
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	Written exam (70 %)
Studienleistung und Gewichtung	Presentation (25 %) with extended abstract (5 %)
Plant Quality (3408-461)	
Person(en) verantwortlich	Günter Neumann Uwe Ludewig Franz Wiesler
Lehrform	Vorlesung mit Seminar
SWS	4
Inhalt	Structure 1. Definition, evaluation and influence of plant quality 2. The external quality of plants 3. The material composition of plants 3.1 Inorganic constituents (ess. minerals, nitrate, heavy metals) 3.2 Organic nitrogen compounds 3.3 Carbohydrates 3.4 Lipids 3.5 Organic Acids 3.6 Vitamins 3.7 Bioactive Substances 3.8 Residues and Contaminants 4. Specific quality issues

	4.1 Plant nutrition and quality of potato, sugar beet quality, quality of fruit, vegetable quality, wine quality 4.2 Plant nutrition and quality of conventional, integrated or alternative crops 5 Biotechnological methods to improve nutritional quality
Literatur	• Current literature • Marschner's Mineral Nutrition of Higher Plants (2011, Academic Press)
Anmerkungen	-

Modul: Plant Symbioses for Nutrient Acquisition (3408-450)

Modulverantwortung	Uwe Ludewig
Bezug zu anderen Modulen	Modules 3302-430 and 3102-430 (Advanced Soil Biology) can only be choosen alternatively because of partly identical lectures.
Teilnahmevoraussetzung	Optional for any master programme in english. Required is knowledge from the module "Pflanzenernährung" with the lectures "Mineralstoffwechsel" and "Organische und mineralische Düngung".
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Crop Sciences - Plant Nutrition and Protection (Master) 3. Semester, elective Agricultural Sciences - Major: Crop Production Systems (Master) 3. Semester, semi-elective Agricultural Sciences - Major: Soil Sciences (Master) 3. Semester, semi-elective Earth and Climate System Science (Master) 3. Semester, elective
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	Broad knowledge on the scientific basis of symbioses between crop plants and N2-fixing microorganisms or mycorrhizal fungi and on their application in plant production. Language skills (scientific English, written and oral), written and oral expression, communication and cooperation skills, presentation training (written and oral), working independently, critical, analytical thinking
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	written exam (100 %)
Studienleistung und Gewichtung	-
Biological Nitrogen Fixation and Mycorrhizae (3408-451)	

Person(en) verantwortlich	Uwe Ludewig
Lehrform	Vorlesung mit Übung
SWS	4
Inhalt	1) Nitrogen cycle, 2) Importance of symbiotic nitrogen fixation in closed ecosystems, 3) Endosymbioses, 4) Taxonomy and biology of N2 fixation, 5) Physiological and biochemical processes in N2 fixation, 6) Genetic and molecular fundamentals of N2 fixation, 7) Physiology and molecular biology of non-symbiotic N2 fixation, 8) Demonstration and practicals in the techniques for the measurement of nitrogenase activity, 9) Targeted application of symbiotic N2 fixation, 10) Quantitative aspects of biological N2 fixation, 11) Methods and applications of mycorrhization, 12) Taxonomy and detection methods of mycorrhizal fungi, 13) Biology of mycorrhizal symbiosis in natural and agro-ecosystems, 14) Question time
Literatur	• Marschner H. 1995. Mineral Nutrition in Hiher Plants. 2nd ed. Academic Press, London. • Taiz L., Zeiger E. 1998. Plant Physiology. 2nd edition. Sinauer Associates Inc., Sunderland, Mass., USA.
Anmerkungen	The course content is derived from the most current scientific literature. Lectures with beamer presentations, demonstrations and practicals. Solving questions. Lecture scripts will be handed out before the lesson begins

Modul: Portfolio-Modul (Master) (3000-410)

Modulverantwortung	Michael Kruse
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	Pro Studiengang kann nur ein Portfolio Modul belegt werden, dieses kann jedoch aus mehreren Leistungen zusammengesetzt werden. _____ The portfolio module can only be taken once per study program. However, it can be composed of several activities / assignments.
Lehrsprache	deutsch/englisch
ECTS	1
Angebotshäufigkeit	jedes Semester
Dauer des Moduls	n. V.
Studiengänge	Agrarwissenschaften - Agricultural Economics (Master) 2./3. Semester, Wahl Agrarwissenschaften - Agrartechnik (Master) 2./3. Semester, Wahl Agrarwissenschaften - Bodenwissenschaften (Master) 2./3. Semester, Wahl Agrarwissenschaften - Pflanzenproduktionssysteme (Master) 2./3. Semester, Wahl Agrarwissenschaften - Tierwissenschaften (Master) 2./3. Semester, Wahl Agribusiness (Master) 2./3. Semester, Wahl Agricultural Sciences in the Tropics and Subtropics (Master) 2./3. Semester, Wahl Bioeconomy (Master) 2./3. Semester, Wahl Crop Sciences - Plant Nutrition and Protection (Master) 2./3. Semester, Wahl Crop Sciences - Plant Breeding and Seed Science (Master) 2./3. Semester, Wahl Earth and Climate System Science (Master) 2./3. Semester, Wahl Environmental Protection and Agricultural Food Production (Master) 2./3. Semester, Wahl Environmental Science - Soil, Water, and Biodiversity (Master) 1./2. Semester, Wahl Landscape Ecology (Master) 2./3. Semester, Wahl Nachwachsende Rohstoffe und Bioenergie (Master) 2./3. Semester, Wahl Organic Agriculture and Food Systems (Master) 2./3. Semester, Wahl ---------- Agribusiness (Master) 2./3. Semester, elective

	Agricultural Sciences - Agricultural Economics (Master) 2./3. Semester, elective Agricultural Sciences - Agricultural Engineering (Master) 2./3. Semester, elective Agricultural Sciences - Animal Sciences (Master) 2./3. Semester, elective Agricultural Sciences - Major: Crop Production Systems (Master) 2./3. Semester, elective Agricultural Sciences - Soil Science (Master) 2./3. Semester, elective Agricultural Sciences in the Tropics and Subtropics (Master) 2./3. Semester, elective Biobased Products and Bioenergy (Master) 2./3. Semester, elective Bioeconomy (Master) 2./3. Semester, elective Crop Sciences - Plant Breeding and Seed Science (Master) 2./3. Semester, elective Crop Sciences - Plant Nutrition and Protection (Master) 2./3. Semester, elective Earth and Climate System Science (Master) 2./3. Semester, elective Environmental Protection and Agricultural Food Production (Master) 2./3. Semester, elective Environmental Science - Soil, Water, and Biodiversity (Master) 1./2. Semester, elective Landscape Ecology (Master) 2./3. Semester, elective Organic Agriculture and Food Systems (Master) 2./3. Semester, elective
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	-
Selbststudium (in Stunden)	-
Arbeitsaufwand (in Stunden)	Es können zwischen 1,0 und 7,5 ECTS credits erworben werden. 1 ECTS credit = etwa 30 h. ---------- Between 1 and 7.5 ECTS credits can be achieved. 30 hours = 1 ECTS credit
Lern- und Qualifikationsziele	Nach Abschluss des Moduls sind die Studierenden in der Lage, • die Grundlagen wissenschaftlichen Arbeitens zu benennen. • interdisziplinäre Schnittstellen bzgl. ihres Studiengangs zu identifizieren und zu beschreiben • eigene Wissenslücken zu erkennen und selbständig zu schließen. • unter Anleitung ein wissenschaftliches Projekt zu planen und durchzuführen.

	• Ergebnisse wissenschaftlichen Arbeitens schriftlich festzuhalten und diese im Rahmen einer Präsentation wiederzugeben. Das Modul vermittelt Schlüsselkompetenzen in unterschiedlichen Bereichen, je nach inhaltlicher Ausrichtung. Zu nennen sind vor allem: Die Befähigung zum selbständigen (wissenschaftlichen) Arbeiten und zur effektiven Informationsbeschaffung und Informationsanalyse durch das selbstständige Erarbeiten eines Themas. Teamfähigkeit, Selbst- und Fremdorganisation und planerische Fähigkeiten durch die Arbeit in Gruppen, Forschungsteams, oder durch ein Praktikum in einem Betrieb, sowie durch die selbstständige Organisation der Tätigkeiten in diesem Modul durch die Studierenden.
empfohlene Vorkenntnisse	-
Anmerkungen	-
Modulprüfung und Gewichtung	Es gibt in dem Modul nur unbenotete Studienleistungen, keine Prüfungsleistung. Eine Anmeldung zur Modulprüfung bei Prüfungsamt ist nicht erforderlich. Reichen Sie Ihre Bescheinigungen beim Modulverantwortlichen Prof. Dr. Michael Kruse ein und zwar ertst dann, wenn Sie alle Bescheinigungen beisammen haben und das Modul abschließen möchten. (Das Modul kann mit 1 - 7,5 ECTS credits abgeschlossen und bestanden werden.) Senden Sie die Bescheinigungen als pdf-Datei per mail an michael.kruse@uni-hohenheim.de. Die ECTS werden durch den Modulverantwortlichen aufgrund der vorgelegten Bescheinigungen bzw. auf Empfehlung der betreuenden Hochschullehrer an das Prüfungsamt gemeldet. Nach Verbuchung erscheinen die credits dann in HohCampus.
Studienleistung und Gewichtung	In dem Portfoliomodul können mit einer oder mehreren Studienleistungen insgesamt zwischen 1,0 und 7,5 ECTS credits erworben werden. Als Studienleistungen werden mit ECTS credits anerkannt (Richtlinie 30 h = 1 ECTS credit): • ein Industrie-/Behörden-/Firmenpraktikum in vor- oder nachgelagerten Bereichen (einschließlich Werkstudierenden-Tätigkeit). Landwirtschaftliche Praktika selbst können im Master nur dann angerechnet werden, wenn kein agrarisch ausgerichteter Bachelor-Studiengang absolviert wurde. Hierbei ergeben 20 Arbeitstage mit 20 seitigem Bericht = 6 ECTS credits. Für andere credit Anzahlen wird linear angepasst (z.B. 10 Tage + 10 Seiten Bericht = 3

credits oder 25 Tage + 25 Seiten Bericht = 7,5 credits). Eine Genehmigung des Praktikums oder des Betriebes ist nicht erforderlich. Das Praktikum kann auch vor dem Studium abgelegt worden sein. Der Bericht samt Praktikumsbescheinigung ist bei einem Prüfungsberechtigten (i.d.R. Prof.) abzugeben. Dieser prüft den Bericht und bestätigt dem Modulverantwortlichen, dass der Bericht angenommen ist und schlägt die Anzahl der zu vergebenden ECTS Punkte vor. Seitens der Fakultät gibt es außer der Seitenzahl keine weiteren Vorgaben für den Bericht. Es ist ratsam, vor Erstellung des Berichts den Prüfungsberechtigten nach seinen Vorgaben zu fragen und diese zu berücksichtigen. Der Modulverantwortliche kann eine Bestätigung darüber ausstellen, dass das Praktikum als Studienleistung anerkannt wird. Das Praktikum kann maximal einmal geteilt werden.

- Individuelles Forschungspraktikum (d.h. der/die Studierende wird z.B. in die Bearbeitung eines wissenschaftlichen Projekts in einem Institut bzw. einer Forschungseinrichtung integriert). Beispiel für 6 ECTS credits: 20 Arbeitstage mit 20 seitigem Bericht oder Arbeitstagebuch, Projektbeschreibung mit Fragestellungen, angewendete Methoden und ggf. Teilergebnisse. Der Bericht ist bei einem Prüfungsberechtigten (i.d.R. Prof.) abzugeben. Dieser prüft den Bericht und bestätigt dem Modulverantwortlichen, dass der Bericht angenommen ist und schlägt die Anzahl der zu vergebenden ECTS Punkte vor.
- Hausarbeit/Literaturarbeit über ein wissenschaftliches Thema (5 - 10 Seiten je ECTS credit). Hierfür ist zunächst ein Prüfungsbereichtigter zu finden, der das Thema vergibt und später die Arbeit annimmt, prüft und dem Modulverantwortlichen bestätigt, dass der Bericht angenommen ist und die Anzahl der zu vergebenden ECTS Punkte vorschlägt.
- Summerschools für postgraduierte Studierende sowie Lehrveranstaltungen auf Master-Niveau, die zum Studiengang passen, nicht zu einer Modulprüfung gehören und die in Hohenheim oder an einer anderen Hochschule belegt wurden. Bitte beim

	Modulverantwortlichen eine Bescheinigung über die Teilnahme einreichen, die den Zeitumfang oder die Anzahl anrechenbarer Credits enthält. • Selbst erstellte und auf Kongressen, Tagungen präsentierte Vorträge/Poster zu wiss. Forschungsprojekten (3 ECTS Punkte). • Vortrag/Poster in einem Seminar außerhalb eines Moduls (1,5 ECTS Punkte) • Sprachkurse (insges. max. 3 ECTS credits). Bitte beim Modulverantwortlichen eine Bescheinigung über die Teilnahme einreichen, die den Zeitumfang oder die Anzahl anrechenbarer Credits enthält. • Fortbildungen im Bereich „Soft Skills“ mit erkennbarem Bezug für das gewählte Studienfach (insges. max. 3 ECTS credits). • FIT-Tutorenausbildung (insges. max. 3 ECTS credits). Das Abhalten des Tutoriums kann nicht anerkannt werden, wenn es im Rahmen eines HiWi-Vertrags erfolgte. Bitte beim Modulverantwortlichen eine Bescheinigung über die Teilnahme einreichen, die den Zeitumfang oder die Anzahl anrechenbarer Credits enthält. • Kurse zu Statistischer Programmierung oder zu Statistikprogrammen (insges. max. 2 ECTS credits). • Leistungsscheine der Virtuellen Akademie Nachhaltigkeit (4302-480) werden mit den darin ausgewiesen Credits anerkannt. Der Studiendekan ist bevollmächtigt, im Einzelfall und auf Antrag des/der Studierenden und ggf. mit Befürwortung eines betreuenden Hochschullehrers weitere Leistungen anzuerkennen. Tätigkeiten in Rahmen einer Beschäftigung (HiWi) an Forschungseinrichtungen der Universität Hohenheim, werden nicht als Studienleistung anerkannt. In Streitfällen bzgl. der Anerkennung von Studienleistungen entscheidet der Prüfungsausschuss.
Portfolio-Modul (Master) (3000-411)	
Person(en) verantwortlich	Michael Kruse
Lehrform	Projekt/Projektarbeit
SWS	5
Inhalt	Für weitere Informationen siehe Modul: Portfolio-Modul (Master) (3000-410)

Literatur	-
Anmerkungen	Bei offenen Fragen senden Sie eine E-Mail anmichael.kruse@uni-hohenheim.de oder kommen Sie in die offene Sprechstunde des Studiendekans montags 12:00 - 13:00 Uhr (Inst. f. Pflanzenzüchtung (350), Fruwirthstraße 21, 1. Stock, links).

Modul: Poverty and Development Strategies (4901-420)

Modulverantwortung	Manfred Zeller
Bezug zu anderen Modulen	Is complemented by module 4901-430 "Rural Development Policies and Institutions".
Teilnahmevoraussetzung	none
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	2. Semesterhälfte
Studiengänge	Agribusiness (Master) 3. Semester, elective Agricultural Sciences in the Tropics and Subtropics (Master) 3. Semester, elective Earth and Climate System Science (Master) 3. Semester, elective Agricultural Sciences - Agricultural Economics (Master) 1. Semester, semi-elective Environmental Science - Soil, Water, and Biodiversity (Master) 3. Semester, semi-elective Bioeconomy (Master) 3. Semester, elective (profile: Bioeconomy Policy Analysis)
Prüfungsdauer (in Minuten)	-
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The students can describe issues and objectives of agricultural and rural development. They can provide an overview of the history of development strategies and theories, current approaches and their problems with special emphasis on economic distribution, poverty reduction and growth and their interdependencies. Independent work, critical and analytical thought, written and oral concise expression, team ability.
empfohlene Vorkenntnisse	-
Anmerkungen	Once not offered in WS 19/20. Please register online via ILIAS.
Modulprüfung und Gewichtung	written exam (100 %)
Studienleistung und Gewichtung	-
Poverty and Development Strategies (4901-421)	

Person(en) verantwortlich	Manfred Zeller
Lehrform	Vorlesung
SWS	4
Inhalt	Students learn methods/indicators to measure development, with a specific focus on agriculture, economic growth, poverty, equality, and food security. This includes indicators of development, such as the Human Development Index, and development objectives and their relationships as well as conflicts between them. Data (mainly from World Bank and UN system) are presented on selected development indicators for all developing regions. This is followed by a review of development theories (classical, balanced/unbalanced growth models, modernization theory, basic needs approach, role of transaction costs and rural institutions) and related development strategies and by a discussion of the underlying factors of development (as derived by the development theories), such as the endowment with natural resources and land, labor and population growth, and human, financial and social capital. The contributions of agriculture for overall development are presented. Students learn also about the institutional setting of development aid. This concerns national and international development institutions including non-governmental organizations (NGOs) with their structures, roles and development approaches. Finally, students are introduced to several rural and agricultural development policies, with an emphasis on the role of the state for agricultural and rural development and sectoral policy instruments related to agricultural and food markets, land and rural finance, agricultural extension, and social safety net / public works policies.
Literatur	Major literature references for the module are: • TODARO, M.P. and S.C.Smith 2003. Economic Development. Harlow, UK: Pearson Education Ltd. • Chenery, H. and T.N. Srinivasan (eds.). 1989. Handbook of development economics. Amsterdam, NL: Elsevier Publishers. • World Bank. Annual issues of the World Development Report. New York, NY,

	• USA: Oxford University Press.- especially Attacking Poverty. World Development Report 2000/2001. • Eicher, C.K., and J.M. Staatz (eds.). 1998. International agricultural development. London, UK: Johns Hopkins University Press (especially articles 6, 7, 10, 11, 15, 17, 19, 20, 24, and 27) • UNDP. Annual issues of the Human Development Report. New York, NY, USA: United Nations Development Program (UNDP).
Anmerkungen	Lecture with discussion, work in small groups, study of literature, reader/script. The reader and powerpoint slides are available in the ASTA-Skriptenbüro.

Tutorial Poverty and Development Strategies (freiwillig) (not offered anymore) (4901-422)	
Person(en) verantwortlich	Manfred Zeller
Lehrform	Tutorium
SWS	1
Inhalt	The exercise will offer students to rehearse selected topics covered in the lecture for which students demand additional opportunity for learning and rehearsal. These topics include: • methods for measuring development in various dimensions (for example gross national product, income inequality, income poverty, purchasing power parity, human development index, food security, global hunger index); • analytical concepts used in various development theories; and exercises regarding price/market analysis and investments in agricultural research (e.g. total factor productivity analysis).
Literatur	-
Anmerkungen	-

Modul: Practical Introduction to Programming with Python (1511-500)

Modulverantwortung	Christian Krupitzer
Bezug zu anderen Modulen	Python knowledge, e.g. from 1511-201, 1511-400, 4407-481, AIDAHO Tools, ILIAS self-study module "Python in a Nutshell".
Teilnahmevoraussetzung	This course is intended for students with a foundational understanding of Python programming. Prior to the third week of the semester (06.11.2023), we expect all participants to possess basic knowledge of programming with Python (variables, boolean algebra, data structures, control structures, functions and modules, working with jupyter notebooks). To ensure a common baseline, we offer a "Python in a Nutshell" refresher course, which covers essential Python concepts. Follow this link to access the materials: Python in a Nutshell
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	M.Sc. Wirtschaftsinformatik, 1. Semester, Wahlpflicht M.Sc. Bioeconomy, 3. Semester, Wahl (Profil: Transforming Food Systems within the Bioeconomy | Data Science and Artificial Intelligence) M.Sc. Earth and Climate System Science, 3. Semester, Wahl
Prüfungsdauer (in Minuten)	90
Präsenzstudium (in Stunden)	42
Selbststudium (in Stunden)	138
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The students will learn the fundamental elements of programming using the Python programming language, as well as relevant tools for development such as ChatGPT, Github Copilot, and CodeX. They will learn how to effectively utilize these tools to support their programming tasks and enhance productivity. Furthermore, the students will be introduced to the basics of computer networks. They will understand how computers communicate and deepen their knowledge through two case studies: the Internet and Industry 4.0. Another focus will be on web development with Python. They will acquire fundamental knowledge about web application

	architecture and be capable of creating rudimentary web applications. Additionally, the students will be introduced to API programming. Lastly, the topic of data analysis will be covered. They will learn how to analyze and visualize data using Python libraries such as NumPy, Pandas, and Matplotlib. Through practical exercises and projects, the students will further develop their skills in Python programming.
empfohlene Vorkenntnisse	-
Anmerkungen	The course will be conducted in a project-based format. In addition to delivering theoretical lecture content, these concepts will be practically applied in projects, with students receiving guidance from tutors
Modulprüfung und Gewichtung	50% written Exam, 50% Assignments (group work permitted)
Studienleistung und Gewichtung	-
Practical Introduction to Programming with Python (1511-501)	
Person(en) verantwortlich	Christian Krupitzer
Lehrform	Vorlesung mit Übung
SWS	-
Inhalt	Programming with Python AI Coding-Tools (e.g. ChatGPT, Github Copilot, ...) Computer Networks Web development with Python API Programming Data Analytics
Literatur	A. Downey: Think Python - How to Think Like a Computer Scientist, Green Tea Press, 2nd edition, 2015. A. Tanenbaum, N. Feamster, and D. Wetherall: Computer Networks, Pearson, 6th edition, 2021.
Anmerkungen	The course will be conducted in a project-based format. In addition to delivering theoretical lecture content, these concepts will be practically applied in projects, with students receiving guidance from tutors.

Modul: Quantitative Methods in Economics (4901-470)

Modulverantwortung	Manfred Zeller
Bezug zu anderen Modulen	This module is considered as basic for all other modules offered to students in the Major of "Rural Development Economics" in the M.Sc. Agritropics.
Teilnahmevoraussetzung	Successfully completed courses in statistics at undergraduate level are assumed.
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	2. Semesterhälfte
Studiengänge	Organic Agriculture and Food Systems (Master) 3. Semester, elective Agricultural Sciences in the Tropics and Subtropics (Master) 3. Semester, elective Bioeconomy (Master) 3. Semester, elective (profile: Sustainable biomass production systems) Earth and Climate System Science (Master) 3. Semester, elective Agricultural Sciences - Agricultural Economics (Master) 3. Semester, semi-elective
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	After completing this module, students: • Know the steps of preparing a field research project • Comprehend the different methods of sampling commonly used in rural areas of developing countries • Are able to utilize about best practices in questionnaire design • Are proficient in various statistical tools to address research questions and to test research hypotheses • Can apply these tools using Stata, a comprehensive statistics software package During preparation for the exam, while preparing and following up on lectures and during the exercises, students practice self-reliance and time management. They learn and practice critical and

	analytical thinking when challenged with statistical analysis. In the exercises, students further practice team work by working in small groups. Skills in professional statistical software such as STATA are indispensable for further scientific work. The skills and competences gained in the course facilitate students to successfully conduct fieldwork activities in rural areas with the highest scientific standard.
empfohlene Vorkenntnisse	-
Anmerkungen	This module targets students from all master programs with a strong interest in empirical quantitative social science research. It is highly recommended to students in their 3rd semester who plan to conduct such research for their master thesis. A certain degree of overlap with module 4902-810 "Applied Econometrics" (compulsory for AgEcon students in their 1st semester) regarding linear regression is unavoidable because the module also targets students from other master programs who may not have chosen "Applied Econometrics" in their 1st semester. However, due to its much broader range of topics, "Quantitative Methods in Economics" is a highly recommended module also and especially for AgEcon students. Please register online via ILIAS. We only accept a maximum of 25 students.
Modulprüfung und Gewichtung	Written exam (100 %)
Studienleistung und Gewichtung	-
Quantitative Methods in Economics (4901-471)	
Person(en) verantwortlich	Manfred Zeller
Lehrform	Vorlesung mit Übung
SWS	3
Inhalt	This module consists of lectures and exercises in the computer lab. Its emphasis is on the design and execution of socio-economic research that investigates issues of rural or agricultural development in developing countries. The course mainly covers quantitative research methods that are used in development economics and in applied socio-economic research in developing countries. The particular contents of the module are as follows: 1) Quantitative research designs in the social sciences 2) The sampling process (constructing sampling frames, sampling procedures, sample size)

	3) The measurement of variables and questionnaire design (with group assignment) 4) Data entry and data cleaning (with computer exercises) 5) Overview of statistical instruments 6) Parametric and non-parametric tests (with computer exercises) 7) Principal component analysis (with computer exercises) 8) Linear regression (with computer exercises) 9) Binary response models (with computer exercises) 10) Matching methods
Literatur	• Black, Thomas R. (1999) Doing quantitative research in the social sciences. An Integrated approach to research design, measurement and statistics. Sage Publications, London. • Field, Andy (2005) Discovering statistics using SPSS. Second Edition. Sage Publications, London. • Hill, R. Carter, Griffiths, William E., and Judge, George G. (2001) Undergraduate econometrics. Second Edition. John Wiley & Sons, New York.
Anmerkungen	-
Exercises to Quantitative Methods in Economics (4901-472)	
Person(en) verantwortlich	Manfred Zeller
Lehrform	Übung
SWS	1
Inhalt	Computer exercises to quantitative methods in economics used in socio-economic research to issues of rural or agricultural development in developing countries.
Literatur	-
Anmerkungen	-

Modul: Remote Sensing of the Earth System (1201-500)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	An advisable complement is the module 3103-440 "Spatial data analysis with GIS"
Teilnahmevoraussetzung	Basic knowledge in mathematics and physics
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 2. Semester, Wahl Promotionsstudiengang Naturwissenschaften (Promotionsstudiengänge, PO vom 14.02.2015) 2. Semester, Wahl Earth and Climate System Science (Master, PO vom 01.10.2017) 2. Semester, Wahl
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The students learn to think in larger spatial and longer temporal scales and recognize evolution as a universal phenomenon. They understand how climate and chemistry of the Earth system developed over long time scales and that it will further change in the future. In addition, the students can distinguish between natural and anthropogenic influences on the Earth system.
empfohlene Vorkenntnisse	Interest in the technical aspects, assumptions, limitations and uncertainties of state-of-the-art remote sensing methods. You need to bring basic skills and interest in physics and mathematics.
Anmerkungen	Maximum number of participants: 20
Modulprüfung und Gewichtung	Written exam
Studienleistung und Gewichtung	Active participation in the exercises, solving the problems.
Remote Sensing of the Earth System, Lecture (1201-501)	
Person(en) verantwortlich	Andreas Behrendt Volker Wulfmeyer
Lehrform	Vorlesung
SWS	2

Inhalt	The observation of the Earth system using remote sensing has fundamental applications for everyday lives of mankind. The module introduces in the physical basis, the methods, and applications of remote sensing from ground-based, airborne, and space borne platforms. The module is equipped with brand-new examples such as hurri-cane watch, wild fire observations, and sea surface temperature measurements for weather forecasting. Please contact Dr. Behrendt (andreas.behrendt@uni-hohenheim.de) or Prof. Wulfmeyer (volker.wulfmeyer@uni-hohenheim.de) for further details.
Literatur	W.G. Rees, Physical Principles of Remote Sensing* C. Elachi, J. van Zyl, Introduction to the physics and techniques of remote sensing, Wiley & Sons, 2006* (some copies of both books are available in the central library of the university).
Anmerkungen	-
Remote Sensing of the Earth System, Excercise (1201-502)	
Person(en) verantwortlich	Andreas Behrendt Volker Wulfmeyer
Lehrform	Übung
SWS	2
Inhalt	Exercise of the content of the lectures with interesting applica-tions of remote sensing for studying variables of the atmosphere and the land surface.
Literatur	-
Anmerkungen	-

Modul: Special Topics of Earth System Science (1201-620)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	All modules from the 1st semester
Teilnahmevoraussetzung	Successful completion of the 1st semester
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes SS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 2. Semester, Wahl Earth and Climate System Science (Master, PO vom 01.10.2017) 2. Semester, Wahl
Prüfungsdauer (in Minuten)	60
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	The Students are able to apply their knowledge from natural sciences and other applied sciences for understanding and analyses of interdisciplinary compelling topics of Earth System Science. Students learn... - Analysis problems from Earth System Science with respect to the interaction between physical, chemical, biological, and economic processes - Set up of corresponding Earth system models of moderate complexity - Analyze the output of the model with respect to input variables, error analyses - Interdisciplinary thinking - Competence to present the analysis of the problem in oral and written manner
empfohlene Vorkenntnisse	Participation in the madatory modules of the first semester.
Anmerkungen	Maximum number of participants: 15

	Registration is open until March 2014. Ranking according to grades in first semester, priority set to students from Earth System Science but the module is also open for other curricula.
Modulprüfung und Gewichtung	presentation (100%)
Studienleistung und Gewichtung	Oral presentation and written report.
Special Topics of Earth System Science (wird nicht mehr angeboten) (1201-621)	
Person(en) verantwortlich	Volker Wulfmeyer
Lehrform	Seminar
SWS	4
Inhalt	Current problems in Earth System Science are introduced and analyzed by the students. Examples are volcanic ash outbreaks, extreme weather events, land-surface-atmosphere exchange, geoengineering. The problems are split with respect to the representation by various disci-plines in Earth System Science and transformed into simple models with non-linear interactions between the components
Literatur	Will be presented in the seminar
Anmerkungen	Late-breaking topics in Earth System Science will be introduced and analyzed.

Modul: UNIcert III English for Scientific Purposes (1000-040)

Modulverantwortung	Lutz Fischer
Bezug zu anderen Modulen	-
Teilnahmevoraussetzung	Scoring at least 85 points in the Language Center's entrance examination OR a UNIcert II certificate or equivalent proof of English language proficiency OR being enrolled in an English-language Master's program at the Faculty of Natural Sciences.
Lehrsprache	englisch
ECTS	7,5
Angebotshäufigkeit	jedes Semester
Dauer des Moduls	2 Semester
Studiengänge	M.Sc. Biologie, 1.-4. Semester, Wahlpflicht B.Sc. Biologie 3.-6. Semester, Wahlpflicht M.Sc. Earth System Science, 1.-4. Semester, Wahl M.Sc. Earth & Climate System Science, 1.-4. Semester, Wahl B.Sc. Ernährungsmanagement und Diätetik, 3.-6. Semester, Wahl B.Sc. Ernährungswissenschaft, 3.-6. Semester, Wahl B.Sc. Lebensmittelwissenschaft und Biotechnologie, 3.-6.Semester, Wahl M.Sc. Ernährungsmedizin, 3. Semester, Wahl M.Sc. Medizinische Ernährungswissenschaft, 3. Semester, Wahl M.Sc. Molekulare Ernährungswissenschaft, 3. Semester, Wahl M.Sc. Molekulare Ernährungswissenschaft (ab Studienbeginn WS 23/24), 3. Semester, Wahl M.Sc. Food Microbiology and Biotechnology, 1.-4. Semester, Wahl M.Sc. Food Biotechnology 1.-4. Semester, Wahl M.Sc. Food Science and Engineering (Master, PO vom 01.10.2013) 1.-4. Semester, Wahl M.Sc. Lebensmittelchemie (Master, PO vom 01.10.2015) 3. Semester, Wahl Promotionsstudiengang Naturwissenschaften, 1./2. Semester, Wahl
Prüfungsdauer (in Minuten)	240
Präsenzstudium (in Stunden)	-
Selbststudium (in Stunden)	-
Arbeitsaufwand (in Stunden)	225
Lern- und Qualifikationsziele	Upon successful completion of this module, the English language proficiency of the students

	corresponds to the level C1 of the Common European Framework of Reference for Languages. For details on the competencies you acquire beyond language proficiency, please read the individual course descriptions at https://spraz.uni-hohenheim.de/kurse?&L=1.
empfohlene Vorkenntnisse	-
Anmerkungen	You need to register for the UNIcert III courses. Information on how to register is available at https://spraz.uni-hohenheim.de/anmeldung?&L=1
Modulprüfung und Gewichtung	UNIcert III examination (240 minutes total): 180 minutes written exam, 30 minutes listening comprehension, 30 minutes oral exam
Studienleistung und Gewichtung	Regular attendance, active participation, other (see individual course descriptions at https://spraz.uni-hohenheim.de/kurse)
UNIcert III English for Scientific Purposes (1000-041)	
Person(en) verantwortlich	Lutz Fischer
Lehrform	Vorlesung
SWS	-
Inhalt	For details on the competencies you acquire beyond language proficiency, please read the individual course descriptions at https://spraz.uni-hohenheim.de/kurse?&L=1.
Literatur	-
Anmerkungen	-

Modul: Weather and Climate Physics (1201-630)

Modulverantwortung	Volker Wulfmeyer
Bezug zu anderen Modulen	Participation at the module Mathematics and Computational Sciences of the Earth System (1102-400) in the same semester.
Teilnahmevoraussetzung	None
Lehrsprache	englisch
ECTS	6
Angebotshäufigkeit	jedes WS
Dauer des Moduls	1 Semester
Studiengänge	Earth System Science (Master, PO vom 01.10.2013) 1. Semester, Pflicht Earth and Climate System Science (Master, PO vom 01.10.2017) 1. Semester, Pflicht Nachwachsende Rohstoffe und Bioenergie (Studienbeginn SS 2019) (Master, PO vom 01.04.2019) 3. Semester, Wahl Nachwachsende Rohstoffe und Bioenergie (ab Studienbeginn WS 19/20) (Master, PO vom 01.10.2019) 3. Semester, Wahl Environmental Science - Soil, Water, and Biodiversity (PO 2014) (Master, PO vom 01.10.2014) 3. Semester, Wahlpflicht Nachwachsende Rohstoffe und Bioenergie (Studienbeginn WS 2018/19) (Master, PO vom 01.10.2014) 3. Semester, Wahlpflicht Environmental Science - Soil, Water, and Biodiversity (PO 2019) (Master, PO vom 01.04.2019) 3. Semester, Wahlpflicht
Prüfungsdauer (in Minuten)	120
Präsenzstudium (in Stunden)	56
Selbststudium (in Stunden)	124
Arbeitsaufwand (in Stunden)	180
Lern- und Qualifikationsziele	Students who complete this module will obtain knowledge of the physical variables and processes related to the earth system and become familiar with the underlying mathmetical equations and formulations. They will be able to independently apply these equations to solve physical problems.
empfohlene Vorkenntnisse	Basic knowledge in physics
Anmerkungen	Maximum number of participants: 10

Modulprüfung und Gewichtung	Written examination
Studienleistung und Gewichtung	None.
Weather and Climate Physics (1201-631)	
Person(en) verantwortlich	Volker Wulfmeyer
Lehrform	Vorlesung mit Übung
SWS	4
Inhalt	Lecture: The order of the topics relates to the chain of processes of the earth system: beginning with the sources of energy, followed by the transport of energy by radiation and ending with thermody-namic processes and thereby caused mass flows. The following topics will be discussed in detail: - Nuclear physics (equivalence of energy and mass; mass defect; nuclear fusion; radioactivity; isotopes; mass spectrometry) - Physics of atoms and molecules (emission and absorption of electromagnetic waves; spectra of atoms, molecules and solid bodies; spectrum analysis) - Radiation (Planck's law of radiation; transmission; scattering) - Thermodynamics (diffusion; heat transport processes; energetics of phase transitions of water; sensible und latent heat; enthalpy; entropy; thermodynamic equilibrium) - Mass flows (laminar and turbulent flow; Reynolds number; Navier-Stokes-equation; flow in a moving reference system; flow in porous matter) Exercises: Solution of assigned physical problems related to the contents of the lecture.
Literatur	-
Anmerkungen	-