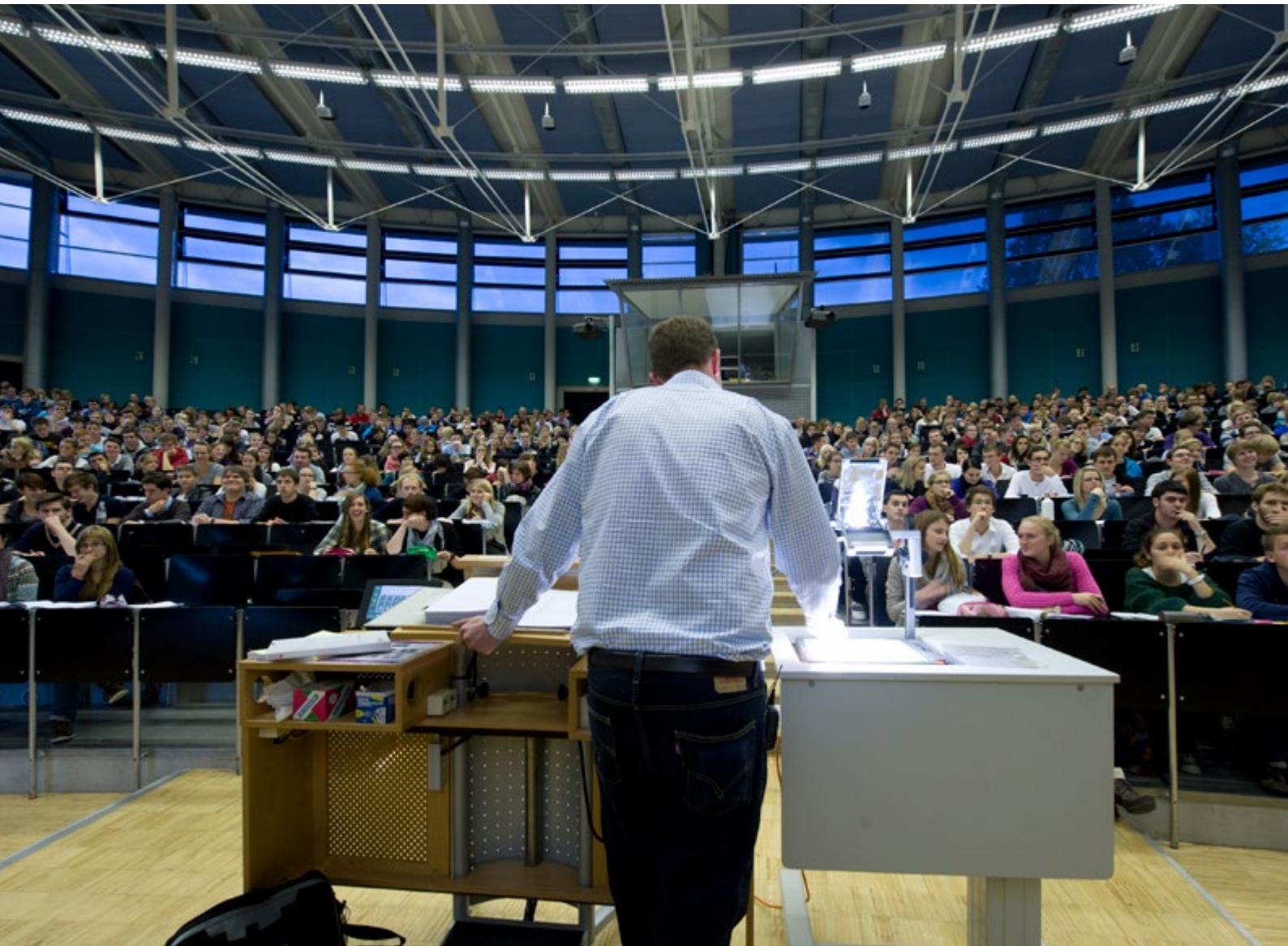
UNIVERSITÄT BAYREUTH

INTERNATIONAL OFFICE

# General Overview of English–Taught Courses at the University of Bayreuth

## Available during the Winter Semester 2024/25

*An overview for the summer semester 2025 is expected to be available as of 01.04.2025*



# Biology, Chemistry and Earth Sciences

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 00030 | Tutorial for "Introduction to Micrometeorology" (Numerical lab to Introduction to micrometeorology) | 1 | Tu | 5; 9; 10 | |
| 00037 | Electrochemistry 2 | 2 | Le | 5 | The lecture extends from the Electrochemistry 1 Module.<br>The following methods will be covered:<br>- Basic Potential Sweep Methods<br>- Controlled-current Techniques<br>- Methods Involving Forced Convection-Hydrodynamic Methods<br>- Techniques Based on the Concept of Impedance<br>The latter portion of this course provides examines the statistical analysis of electrochemical experiments. Emphasis is placed on parameter inversion techniques, and regression analysis applied to electrochemical impedance spectroscopy as an example. The course also explores the application of both frequentist and Bayesian methodologies for experimental design, as well as concepts of active learning, rapid data acquisition, segmented models, and asymptotic analysis. Simulation-based learning is integrated throughout to reinforce the theoretical concepts with practical application.<br>The practical training part of this module will be hosted in the labs of the Chair of Electrochemistry. The precise experiments will depend on the available equipment at the start of the module.<br>Possible experiments are as follows:<br>- Ionic conductivity determination of solid electrolytes (via impedance spectroscopy, two-electrode measurement)<br>- Cyclic voltammetry of (quasi)reversible redox couples<br>- Assembly and galvanostatic (constant-current) cycling of Li–ion coin cells<br>- Double-layer capacitance characterization of inert electrolytes via cyclic voltammetry and impedance spectroscopy (three-electrode measurement)<br>- Determination of electrochemical stability window of an electrolyte via stepwise voltammetry (two- or three-electrode measurement)<br>- Rotating ring-disk electrochemistry: three-electrode measurement, calibration and determination of faradaic efficiency of generated oxygen.<br>Learning Objectives: Acquiring competence in the field of electrochemistry, especially in terms of methodology (both theoretical and practical).<br>Specifically, by the end of this course students should be able to:<br>- Describe how linear and/or cyclic voltammetry can be used to characterize the thermodynamic and kinetic properties of an electrochemical reaction.<br>- Describe how the method of impedance spectroscopy works and how it can be utilized to characterize solid samples as well as solid electrode-liquid interfaces.<br>- Discuss the similarities and differences between controlled potential and controlled current methods for characterizing electrochemical systems.<br>- Discuss the advantages and short-comings of convection-controlled electrochemical methods (hydrodynamic electrochemistry)<br>- Proficiently build three-electrode and two-electrode cells, and confidently used the methods outlined above to characterize the cell performance.<br>- Analyze electrochemical data using statistical techniques, including sensitivity analysis and asymptotic statistics.<br>- Describe methods of optimal experimental design employing simulations for practical understanding.<br>Examination mode: Written examination (90–120 minutes) OR oral examination (20–40 min) (90% of module final grade) and practical training reports, (10% of module final grade). |
| 00040 | Electrochemistry 2 | 1 | Int | 5 | This Practical will be hosted in the Labs of the Chair of Electrochemistry. The precise experiments will depend on the available equipment at the start of the Module.<br>Possible experiments are as follows:<br>- Ionic conductivity determination of solid electrolytes (via impedance spectroscopy, two-electrode measurement)<br>- Cyclic voltammetry of (quasi)reversible redox couples<br>- Assembly and galvanostatic (constant-current) cycling of Li–ion coin cells<br>- Double-layer capacitance characterization of inert electrolytes via cyclic voltammetry and impedance spectroscopy (three-electrode measurement)<br>- Determination of electrochemical stability window of an electrolyte via stepwise voltammetry (two- or three-electrode measurement)<br>- Rotating ring-disk electrochemistry: three-electrode measurement, calibration and determination of faradaic efficiency of generated oxygen. |
| 00041 | Electrochemistry 2 | 1 | Tu | 5 | |

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|---|---|---|---|---|---|
| 00043 | Impedance Methods for Interface Characterization | 2 | Le | 5 | Learning Objectives: This module aims to deepen the expertise of the students in the method of electrochemical impedance spectroscopy for interfacial characterization. The fundamentals of the method will be presented, and the students will have the opportunity to become proficient in the analysis of impedance spectra of interfaces relevant to energy storage systems.<br>The lecture will cover various process models to describe impedance spectra, including but not limited to, equivalent circuit analogs and kinetic models. Furthermore, frequency dispersion and its relevance to electrode roughness as well as porous electrodes will be discussed. Finally, the challenges for interpreting 2- vs. 3- electrode impedance responses will be presented. At the end of the lecture, topics will be assigned to each student from which they need to prepare a presentation, including their own assessment/interpretation of the impedance results.<br>Teaching methods: The lectures will cover the above-mentioned material using textbooks and recent literature on electrochemical energy research to convey the relevance and applicability of the theory of impedance spectroscopy. The lectures are complimented with active learning sessions in which the students will be able to measure and/or simulate and analyze impedance data with specialized software.<br>Recommended prior knowledge: It is recommended that the students have completed the Electrochemistry 1 and Electrochemistry 2 modules, as well as all assigned Alignment Modules<br>Examination mode: Written final examination (90–120 minutes) OR oral final examination (20–40 min). The type of examination will be communicated at the beginning of the module and counts for 75% of the module final grade. A presentation at the end of the module counts for 25% of the module final grade. |
| 00044 | Impedance Methods for Interface Characterization | 1 | Se | 5 | |
| 00074 | Fundamentals of Physical Chemistry for Electrochemical Energy Storage Systems | 1 | Tu | 5 | |
| 00110 | Orientation Week Environmental Chemistry | 2 | Cs | – | |
| 00155 | Experimental ecology | 1 | Le | 5 | - Scientific research methodology<br>- Principles of experimental designs<br>- Types of experimental designs<br>- Trait measurement and data analyses<br>- Structure of scientific publications<br>Learning Objectives: To gain experience in the scientific research methodology: identifying knowledge gaps, generating questions/hypotheses, collecting data, analyzing, interpreting, and presenting the results. To design and run a small greenhouse experiment to test questions/hypotheses<br>Teaching methods: Students plan their own greenhouse experiments under the supervision of the lecturer.<br>Recommended prior knowledge: Basic knowledge in plant ecology<br>Examination mode: Presentation of the research question, experimental designs, and results (ungraded).<br>Grading depends on a written project paper which includes a research question/hypothesis, methods (experimental design & data collection), results, and discussion. The paper should meet the general requirements of a scientific publication. |
| 00187 | Python programming in the life sciences | 2 | Se | 9 | This module provides an introduction to the Python programming language. The aim is to teach students how to program in Python using problems from biochemistry and bioinformatics. Basic algorithms from bioinformatics are taught in order to process, analyze and present scientific data. |
| 00188 | Python programming in the life sciences | 2 | Tu | 9 | This module provides an introduction to the Python programming language. The aim is to familiarize students with programming in Python using problems from biochemistry and bioinformatics. Basic algorithms from bioinformatics are taught in order to process, analyze and clearly present scientific data. Programming tasks are worked on in class. |
| 00189 | Python programming in the life sciences | 7 | Int | 9 | This module provides an introduction to the Python programming language. The aim is to familiarize students with programming in Python using problems from biochemistry and bioinformatics. Basic algorithms from bioinformatics are covered in order to process, analyze and present scientific data. Students will work independently on their own programming project. |
| 00441 | Biodiversity in the tropics | 2 | Le | 5; 9 | The module first provides an introductory overview of tropical ecology. Using tropical forests, one of the most species-rich systems on earth, the theories and the current state of knowledge on the mechanisms of the formation and maintenance of diversity, on the processes that determine the spatial and temporal distribution of diversity, on the function of diversity, on the influences of climate change and land use, and on conservation strategies will then be taught. Genetic, chemical, functional and species diversity as well as various taxonomic groups are included.<br>Learning Objectives: Students should gain a sound overview of tropical ecology and in particular of biodiversity research in the tropics. At the same time, various approaches to developing and testing ecological hypotheses will be developed using examples, and critical analysis of the scientific literature will be practiced. The scientific processing and analysis of biodiversity data as well as scientific presentations will be practiced.<br>Recommended prior knowledge: Fundamentals of animal ecology, plant ecology and evolution from basic studies.<br>Basic knowledge of statistics is required, R is an advantage.<br>Exam registration: To register for participation, you must identify yourself as a student in CAMPUSonline.<br>Examination mode: Participants will receive a grade for their performance in the preparation and presentation of seminar papers and posters with written elaborations. |

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|---|---|---|---|---|---|
| 00563 | Tutorial for the lecture "Experimental Ecology" | 4 | Tu | 5 | - Designing, setting up, and running a small greenhouse experiment<br>-Measuring plant traits<br>- Data analyses<br>Learning Objectives:<br>- To gain experience in the scientific research methodology: identifying knowledge gaps, generating questions/hypotheses, collecting data, analyzing, interpreting, and presenting the results.<br>- To design and run a small greenhouse experiment to test questions/hypotheses<br>Teaching methods: Students plan their own greenhouse experiments under the supervision of the lecturer.<br>Recommended prior knowledge: Basic knowledge in plant ecology<br>Examination mode: Presentation of the research question, experimental designs, and results (ungraded). Grading depends on a written project paper which includes a research question/hypothesis, methods (experimental design & data collection), results, and discussion. The paper should meet the general requirements of a scientific publication. |
| 00578 | Fundamentals of Inorganic Chemistry for Electrochemical Energy Storage Systems | 2 | Le | 5 | |
| 00579 | Battery Materials I | 2 | Le | 5 | |
| 00581 | Battery Materials I | 1 | Tu | 5 | |
| 00635 | Atmospheric Chemistry I - Hands-On<br>(A1 Part2 / WV30) | 2 | Se | 2; 5; 9 | The "Atmospheric Chemistry I - Hands On" provides insights into atmospheric historical and recent literature in the format of a Journal Club. With a small, self-organized experiment, concepts of how to obtain and analyze atmospheric data sets are introduced. |
| 00730 | Field Methods for Plant Ecology | 6 | Tu | 8; 9 | Learn experimental design for ecological studies. Describe frequency, architecture and functional characteristics of plants. Comply with the requirements of Open Science. Understand the ecological effects of fire, herbivory, nutrients, soil and climate on plants.<br>Teaching methods: All assignments are written in German. |
| 00750 | Biodiversity in the tropics | 2 | Se | 5; 9 | The module first provides an introductory overview of tropical ecology. Using tropical forests, one of the most species-rich systems on earth, the theories and the current state of knowledge on the mechanisms of the formation and maintenance of diversity, on the processes that determine the spatial and temporal distribution of diversity, on the function of diversity, on the influences of climate change and land use, and on conservation strategies will then be taught. Genetic, chemical, functional and species diversity as well as various taxonomic groups are included.<br>Learning Objectives: Students should gain a sound overview of tropical ecology and in particular of biodiversity research in the tropics. At the same time, various approaches to developing and testing ecological hypotheses will be developed using examples, and critical analysis of the scientific literature will be practiced. The scientific processing and analysis of biodiversity data as well as scientific presentations will be practiced.<br>Recommended prior knowledge: Fundamentals of animal ecology, plant ecology and evolution from basic studies.<br>Basic knowledge of statistics is required, R is an advantage.<br>Exam registration: To register for participation, you must identify yourself as a student in CAMPUSonline.<br>Examination mode: Participants will receive a grade for their performance in the preparation and presentation of seminar papers and posters with written elaborations. |
| 00810 | Seminar for Bachelor's and Master's candidates and doctoral students | 2 | Se | – | |
| 01091 | Atmospheric Chemistry I – Introduction<br>(A1 Part1 / BGCP2-1) | 2 | Le | 5; 6; 10; 12 | The lecture provides a wide overview of the environmental impact of atmospheric constituents. Fundamental concepts of chemical reactions in the troposphere and stratosphere are introduced. The importance and danger of greenhouse gases, the formation of photochemical smog, and the natural and disturbed ozone layer are examples that are discussed by means of landmark publications and deepened within small exercises. |
| 20020 | Disturbance Ecology Field Trip<br>(Overseas) | 10 | Ecn | – | Based on theoretical and methodological knowledge about different approaches in disturbance ecology and vegetation science, various eco-logical field talks and methods of data recording are applied to a large diversity of habitats and ecosystem dynamics. Site conditions and eco-system processes are related to key plant functional traits and vegetation pattern. Methods include floristic relevés, vegetation transects, trait data recording as well as assessment of ecosystem functioning and resilience.<br>Learning Objectives: Module aim is an advanced practical experience in disturbance ecology and vegetation dynamics while traveling hiking through remote landscapes. Students are trained in the field across a variety of ecosystems and altitudinal gradients and will understand the effort and the skills needed for analyzing natural and anthropogenic disturbance regimes and their effects on ecosystem dynamics in various regions. Field talks and scientific field work will be carried out at the scale of plant communities and ecosystems targeting various biomes. Concepts and methods taught in disturbance ecology and resilience, biodiversity and vegetation science are applied under field conditions. The final product will be an individual fieldbook of disturbance ecology and vegetation dynamics based on own work and experience.<br>Teaching methods: Knowledge from the lectures "Disturbance Ecology" and "Vegetation Science" is prerequisite. Skills in plant species determination are welcome. Physical fitness is needed. |

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|---|---|---|---|---|---|
| 20038 | Advanced Remote Sensing | 2 | Cs | 5; 10 | In the Advanced Remote Sensing course, students will learn about some advanced skills for image processing and information extraction from satellite optical, thermal and radar data sets. There are two key modules in this course to cover theories and practical exercises. The main focus of both modules is on the most recent and open access satellite images and image processing software programs. Students will learn how to employee Sentinel-1 SAR images, Sentinel-2 optical images, Sentinel-3 thermal, and Sentinerl-5, mainly in SNAP and ENVI, to solve a *real world* issue in several fields such as water quality monitoring, oil spill mapping, urban built area extraction, flood monitoring, snow cover mapping, rice detection, crop mapping, land surface temperature estimation, forest and deforestation monitoring, pollution monitoring, anomaly detection, burn indices etc.... |
| 20039 | Debated Topics in Environmental Geography | 2 | Ad. Se | 5; 6 | The seminar should create an awareness that scientific topics could be discussed controversially based on facts compiled by scientific work. Each topic will be prepared by two persons, one presenting a pro and the other a contra position. Afterwards the topic is discussed by the whole group. Topics not presented will be discussed using papers.<br>The discussed topics are:<br>- Should we define a new geological era named *Anthropocene*?<br>- Do organisms form a self-regulating, complex system that maintains Earth a habitable planet (the GAIA principle)?<br>- Do extreme events increase due to global warming?<br>- Is there such a thing like *climate refugees*?<br>- The limits to growth - outdated or more topical than ever?<br>- Is a certain rate of soil erosion tolerable and sustainable?<br>- Is the valuation of ecosystem services a sound concept for the sustainable use of natural goods?<br>-Globalization of environmental planning and protection. Are global initiatives and conventions *ecological imperialism*?<br>- "Use it or loose it" - The only way to protect the environment?<br>- Is pollution increasing?<br>- Should scientists increase the impact of their work on society? |
| 20085 | Global Change and Agroecosystems | 2 | Se | 3; 5; 6; 9; 10; 15 | |
| 20113 | Earth, Soil, Surface I (B1/ÖLD2 Process Geomorphology, lecture/ seminar) | 2 | Cs | 5; 6; 15 | In the class we will deal with advanced concepts of geomorphology (e.g. systems, equilibrium, thresholds, quantitative aspects). This introduction is followed by an overview of field work techniques like erosion and transport measurements, laser scanning and shallow geophysics. The class is a mixture of lecture by O.S., short presentations of key literature by the students, and short quantitative excercises. There will be a written exam in the end of the semester.<br>Recommended prior knowledge: Basic knowledge of geomorphology is required, e.g:<br>AHNERT, F.: Introduction to Geomorphology; Arnold, London (English)<br>AHNERT, F.: Introduction to Geomorphology; UTB. (german)<br>Examination mode: short presentation(s) by each student; Small quantitative excercises; Short written exam (60 mins) in the end of the semester |
| 20139 | Emerging Topics in Rhizosphere Research | 2 | Se | 5; 9 | |
| 20310 | Mixed Models with R: A workshop for advanced users | 3,5 | Int | 3,15 | In this practical workshop, participants will work together to develop an R script that deals with the various possibilities of linear regression using mixed models. Simple regression models will be analyzed to understand their conditions and weaknesses using real research data. It also demonstrates how these models can be extended to overcome challenges such as variance heterogeneity or autocorrelation. In addition to linear regression, a form of non-linear regression in the form of additive models is also discussed.<br>Although the underlying R code and its application are an important part of this course, the focus is on the theory and the various stumbling blocks and rules to be observed with these complex models. Participants will receive a script that they can use as a reference for code parts in the future if they are confronted with similar problems in their future careers.<br>Learning Objectives: Participants will be familiar with the numerous rules and stumbling blocks in the application of mixed models and will be able to take appropriate measures to recognize and solve potential difficulties.<br>Teaching methods: The course takes place over two weeks on a half-day basis. A script will be produced using a combination of demonstrations, individual and group exercises and discussion. The jointly developed script will be followed up by the participants and an exam will be written. This semester, the course will be offered in English, although questions and answers as well as repetitions can also be given in German if desired.<br>Recommended prior knowledge: For this workshop, you should have basic knowledge of working with R and basic knowledge of statistics, such as ANOVA and ANCOVA. Participants of my beginner workshop should be able to follow this course.<br>An own laptop is required. |
| 25180 | Trends in Biogeography | 1 | Se | 1; 5 | Different trans-disciplinary publications, both in content and methods, are offered and discussed in small groups.<br>Learning Objectives: The students will be able to understand and discuss recent theories and concepts of Biogeography and deal critically with these. In parallel, the basic principles of scientific work will be taught. Furthermore, personal and social-communicative competencies in the sense of independent development, evaluation and presentation of research topics will be trained in-tensively in small groups.<br>Miscellaneous: Take Place every friday from 11–12 am in GEO II biogeo seminar room 1.23 |

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|---|---|---|---|---|---|
| 20144 | Current Issues in Economic Geography<br>(Food, Agriculture and Nutrition in the Age of Financialized Capitalism) | 2 | Ad. Se | 4; 5; 6; 8; 10 | Since the global financial crisis, the world has seen a strong rise in financial investment in farming and agricultural production. Indeed, financial investors have been singled out as one of the main causes of the so-called "*global land rush*". As of more recently, actors such as venture capital firms have also discovered agricultural technologies and food and nutrition as a new investment frontier. Silicon Valley has gone farming. In a world with a growing population that needs to be fed, the financial returns from agriculture and food production are sold as safe bets. These trends occur in a global food system that has seen rapid transformations over the past 100 years, particularly since the 1970s. The debates that these trends have prompted have frequently been alarmist, with financiers having been blamed for rising land prices, corporate enclosures, the dispossession or dislocation of (smallholder) farmers, the expansion of large-scale industrial, environmentally harmful agriculture and the rise of new technological oligopolies in the farming and food sector.<br>In this course, we will read the book Farming as Financial Asset – Global Money and the Making of Institutional Landscapes (Ouma, 2020, Agenda/Columbia University Press; www.agendapub.com/page/detail/farming-as-financial-asset/?k=9781788211871). The book combines numbers and narratives, offering both a data-centered as well as an ethnographic account of finance run on farmland and agricultural production, enriched with an analysis of case studies taken from Aotearoa New Zealand and Tanzania. It also takes a deep historical dive into finance's affair with food and agriculture. We will use the book to discuss broader themes, such as the transformation of the agri-food system by corporate actors, increasing land inequality, the looming ecological crisis and agricultural/food/nutrition futures.<br>The seminar takes an interdisciplinary approach and will be of interest to students in geography, global change ecology, development studies, global history, global food, health and nutrition, philosophy and economics, among others. It offers the unique opportunity to discuss a global mega-trend across neat north-south binaries. The phenomena discussed in the book materialize in many countries around the globe (e.g. the US, Brazil, Argentina, Australia, Germany, Romania, Hungary, South Africa, Laos etc.). The seminar also offers students to engage critically with the work of a selected author, who happens to be the instructor of the course. This also offers a unique learning opportunity for the author/instructor. Development studies students can have this credited as a thematic seminar.<br>Teaching methods:<br>Workload: The seminar is credited with 5 CPs. If students need more credit points, we can negotiate a package. We will read the book one chapter at a time. The list of chapter is as follows:<br>Introduction<br>Optic: how do we study the finance-farming nexus?<br>History: how old is the finance-farming nexus?<br>Numbers: what we know (and do not know) about finance-gone-farming<br>States: how are foreign investments in farming regulated and accounted for?<br>Value(s): why has the road to "*greener pastures*" been so bumpy?<br>Delegation: what happens inside the agri-investment chain?<br>Grounding: what does assetization look like from below?<br>Radices: food futures, with or without finance as we know it?<br>Epilogue: We are likely to spend 105 minutes each (instead of the usual 90) discussing the chapters, having a response paper, and a discussion. This will involve one person/team of two each presenting a chapter and discussing it in terms of the key message, unclear points, and possible practical conclusions.<br>The response paper should focus on the omissions of the Ouma chapter assigned. Ouma speaks from a particular social, epistemic, and geographic positionality. Other thinkers, including ones from the Global South have thought about the finance-driven rush for agriculture in different terms or highlighted different issues.<br>The response paper should:<br>- briefly appreciate the contribution of the chapter<br>- identify shortcomings/omissions of the chapter from the perspective of the book you have read?<br>- outline clearly what what won if Ouma's account took up something from your assigned book chapter/paper?<br>- Flag one to two questions for further debate.<br>Participation criteria & registration: The seminar is accompanied by an exercise (Übung) of 2 SWS (5 CP) where students will develop a practical project based on the seminar reading.<br>If you would take this course, please register separately via CM Life. |
| 20309 | Statistics with R:<br>A workshop for beginners | 3,9 | Int | 3; 15 | In this practical workshop, we will work together to develop an R script that illustrates the basic and most important functions of R. Although the focus is on the code and the required knowledge of how R works, the most important statistical methods (e.g. linear regression and non-parametric tests) will also be explained in more detail using real experimental data. Important prerequisites for these procedures are also discussed and reviewed. In addition to statistics, data visualization methods (e.g. graphs) are also discussed and demonstrated using a number of practical examples. Finally, we will also look at how to (further) develop simple algorithms in order to be able to work better and more easily with R.<br>In addition to explanations and demonstrations, regular exercises, individually and in small groups, ensure variety and internalization of what has been learned. Participants are encouraged to review the script and practice with their own data in order to clarify any questions or comprehension problems. The participants thus receive a script that they can also use in the future as a source for code parts if they face various problems in their future careers.<br>Learning Objectives: After this course, participants will be able to work with R and RStudio, process their own data and apply basic statistical methods with confidence. Participants will be able to program their own simple algorithms, which will provide a basis for practicing these skills independently.<br>Teaching methods: The course is held in two weeks, half days. A script is developed in a mixture of demonstrations, individual and group exercises and discussions. The jointly developed script will be reviewed by the participants and an exam will be written.<br>This semester, the course will be held in English to give English-speaking students the opportunity to participate. However, I can also repeat individual parts in German and questions and answers can also be given in German.<br>Recommended prior knowledge: No prior knowledge is expected for this workshop. However, even beginners with some experience in R can learn a lot from this course and improve their skills.<br>You should have your own laptop. |

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| 20356 | Fundamentals of Ecotoxicology | 3 | Tu | 5 | In the block course, basic principles of ecotoxicology are introduced and methods of toxicity bioassays and chemical residue analysis are tried out in practice.<br>Learning Objectives: The general objectives of the module are to teach 1) basics of ecotoxicology, as well as current theories, hypotheses and controversies in this field of research; 2) practical basics of toxicity testing and residue analysis; 3) basics of statistical data analysis, experimental design and reproducibility, methods of data aggregation and risk assessment.<br>Teaching methods: The exercise is offered as a block course. After a theoretical introduction, concepts will be tried out in practice in the laboratory. A report is written on the results of the conducted experiments. In the "Advanced Ecotoxicology" seminar, topics of eco-toxicology and risk assessment are discussed in more detail. The specific content and the form of the literature work are flexibly oriented towards the interests of the participants.<br>Recommended prior knowledge: None<br>Examination mode: Participants receive a grade consisting of the assessment of a written report for the block course (50%) and an assessment of the seminar contribution (50%). Depending on the specific content of the seminar, the seminar work can take the form of an oral presentation or a written report. |
| 20480 | Simulation in soil physics with Hydrus-1D | 2 | Le & Tu | 3,4; 6 | This course provides an introduction to water flow simulations with Hydrus -1D. The course targets two important spatial scales in soil physics/soil hydrology: the laboratory scale (small laboratory columns, 5–100 cm) and the field scale (pedon 1–10 m). Participants will learn the basic terminology of water flow simulations, the basic assumptions behind simulations using Hydrus -1D, how to set up and run their own simulations, how to work with the output files, how to plot data, and how to draw conclusions from their simulation results. The course consists of a series of short lectures followed by computer exercises.<br>The main parts are:<br>1. introduction to the course and to the theory of simulation of water flow with Richards equation, basics on numerical solutions and terminology<br>2. introduction to Hydrus -1D and first simulations<br>3. laboratory scale: simulation of the laboratory method for measuring water retention curves (how much time do our samples need to reach equilibrium conditions, what is the spatial distribution of the matrix potential in the soil column)<br>4. from laboratory data to simulations. How are WRC data converted into mathematical models of the water retention curve (RETC software)?<br>5. laboratory scale: simulation of the laboratory method for the estimation of Ksat and K(h) (Darcy equation).<br>6. from laboratory data to simulations. Conversion of laboratory data into mathematical models of soil hydraulic properties (RETC).<br>7. laboratory scale: simulation of infiltration experiments of water in soil columns, (effect of boundary conditions)<br>8. field scale: Drainage of a soil profile due to gravity, evaporation and water uptake by roots, discussion of the following concepts: Field capacity, permanent wilting point, available water content and storage.<br>9th field scale: simulation of stationary water profiles above a water table (effect of precipitation and/or evaporation)<br>10th field scale: simulation of perennial water dynamics under realistic BCs. How do the main water balance components differ between a wet and a dry year for different soil types?<br>11th field scale: Heat transport in soils. How fast do different soil profiles warm up on a given day, but also in a given season?<br>Learning Objectives: Knowledge<br>1. acquire theoretical knowledge about the simulation of water flow in porous media/soils<br>2. expand your knowledge of the measurement principle in the soil physics laboratory<br>Skills<br>1. design, set up and perform a 1D simulation of water flow using Hydrus- 1D<br>2. work with output files, import them into Excel and perform post-processing.<br>3. fit mathematical equations to data<br>Skills<br>1. evaluate different soil types in relation to soil hydrology, hydrology and ecohydrology<br>2. evaluate soil as a growth medium for plants<br>Teaching methods: Short lectures followed by computer exercises. Active participation of students through theoretical calculations, discussions, group work.<br>Lectures: 10–20%<br>Computer exercises: 80–90%<br>Expected workload: 30 h actual lab work + 30 h preparation, group work, presentations<br>Recommended prior knowledge: Module G2.1: Pedosphere 1 is required<br>Participation criteria & registration: This course complements the course "Experimental Methods in Soil Physics". To participate in the Hydrus-1D course, it is necessary to have taken the course "Introduction to Soil Physics" and the course "Experimental Methods in Soil Physics".<br>Examination mode: Written report for the laboratory part and oral exam with questions on the report, but also on the simulation part. |
| 20523 | Radioisotopes and Tracer Experiments | 1 | Le | 5 | |
| 20554 | Rhizosphere Biogeochemistry and Biophysics | 2 | Le | 5; 10 | |

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|---|---|---|---|---|---|
| 20357 | Advanced Ecotoxicology | 2 | Se | 5 | In the seminar which takes place during the lecture period, the acquired basic knowledge is used to critically reflect on, discuss and summarize current scientific research.<br>Learning Objectives: The general objectives of the module are to teach 1) basics of ecotoxicology, as well as current theories, hypotheses and controversies in this field of research; 2) practical basics of toxicity testing and residue analysis; 3) basics of statistical data analysis, experimental design and reproducibility, methods of data aggregation and risk assessment.<br>Teaching methods: The exercise "Fundamentals of Ecotoxicology" is offered as a block course. After a theoretical introduction, concepts will be tried out in practice in the laboratory. A report is written on the results of the conducted experiments. In this seminar, topics of eco-toxicology and risk assessment are discussed in more detail. The specific content and the form of the literature work are flexibly oriented towards the interests of the participants.<br>Recommended prior knowledge: None<br>Examination mode: Participants receive a grade consisting of the assessment of a written report for the block course (50%) and an assessment of the seminar contribution (50%). Depending on the specific content of the seminar, the seminar work can take the form of an oral presentation or a written report. |
| 20642 | Research module inorganic active materials written report | 12 | Pj | 10 | Possible research topics of the chair are:<br>Prof. Bianchini:<br>- Synthesis and characterization of positive electrode mate-rials for Li-ion batteries with disordered rock-salt frame-work<br>- The spray-drying method to synthesize electrode materi-als and protective coatings<br>- Novel halide solid-state electrolytes for Na-ion batteries<br>- Development of hard carbon materials as Na-ion battery anodes<br>- Synthesis and characterization of electrode materials based on the spinel crystal structure<br>- Sol-gel synthesis of Mn-based NASICON electrode materials and basic characterization<br>In situ x-ray diffraction to investigate battery electrode materials<br>Dr. Wang:<br>- Operando electrochemical characterization of a Li-rich high-entropy disordered rock-salt cathode for lithium-ion cells<br>- Influence of the morphology on the electrochemical per- formance of high-entropy layered oxides for sodium-ion batteries<br>- Mechanochemical synthesis of Li-rich over-stoichiometry high-entropy disordered rock-salt cathode for lithium-ion batteries<br>- Improved electrochemical performance by surface coating for Na-ion layered oxide cathode<br>Learning Objectives: Students should gain an insight into current research practice. In addition, they should acquire experimental skills through independent laboratory work under supervision, and teamwork and presentation techniques should be practiced.<br>Teaching methods: The learning content relates to the current research projects of the chair. The module includes experimental work, literature work, participation in the working group seminars with own presentation and the preparation of a protocol.<br>Recommended prior knowledge: Successful completion of all individual alignment modules and at least three compulsory modules. |
| 20643 | Research module Inorganic active materials Presentation | 1 | Se | 10 | |
| 20659 | Modeling Soil-Plant-Atmosphere Systems | 4 | Le & Tu | 5; 6; 10 | The content of this lecture/exercise course is the simulation of water flow and solute transport in soils and in plant roots. First, the principles of water flow and solute transport in permeable media will be introduced. Then flow equations at the continuous scale will be derived (i.e. Richards' equation, the advection-dispersion equation, water flow across the roots).<br>Some analytical solutions will be derived (capillary rise, radial flow), while for more general cases the finite difference and finite elements method will be explained. In the second part of the lectures, the students will work in teams to solve selected numerical problems, such as: 1) a three-dimensional water uptake by root architecture and the identification of optimal root traits for water acquisition from drying soils, 2) determination of the soil water retention curve and the unsaturated conductivity by inverse modelling of an evaporation experiment performed in the class, and 3) the application of a pore-scale percolation model to describe water infiltration in water repellent soils. |
| 20668 | Soil and Plant Hydrology (New: Soil structure and soil functions) | 2 | Le | 5; 9; 10 | The module goal is to learn how soil management and various (a)biotic drivers affect the structure of soils and herewith multiple soil functions at different temporal scales.<br>Agroecosystem management alters soil structure and thus various soil functions. In addition, bioturbation and climatic conditions induce seasonal dynamics in the pore network and thus in the architecture of the soil. Quantifying these changes provides critical information about soil as a habitat and water as a key resource for plant production. In addition, soil structure plays a crucial role for water and matter fluxes in agroecosystems. In this module, we learn about soil structure as a dynamic soil state, methods to quantify structural indicators and how these structural changes modify soil functions. We will further discuss how management systems can be adapted in prospect of future scenarios.<br>The course provides a general overview of soil structure, how it is changing by various drivers (tillage, freezing/thawing, wetting/drying, bioturbation), as well as the feedback mechanisms for soil functions and implications for resource management in agroecosystems.<br>Learning Objectives: This module is offered annually in the winter semester and is meant to be completed within one semester.<br>Teaching methods: The total workload for this course is 150 h, and can be subdivided into active participation in 2 courses 60 h, preparation and follow-up of 60 h, and seminar contribution of 30 h.<br>Recommended prior knowledge: None. Basic knowledge in soil science is highly recommended. We encourage students without basic knowledge to participate the module: Introduction to Soil Chemistry (Soil Science)<br>Examination mode: The workload of this module is equivalent to 5 ECTS.<br>Successful completion of the learning outcomes will be assessed via 1) seminar presentation and 2) written examination at the end of the semester. Only the written examination will be graded. |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 20695 | La Palma Science School (field exercise and seminar) | 10 | Tu | 2; 5; 9; 10 | Different trans-disciplinary topics, both in content and methods, are offered every year. All topics relate to key ecological processes at the scale of ecosystems.<br>Discussions in small groups, introduction to the target ecosystems, guidance in sampling design, support of data collection and statistical analysis, review of manuscript drafts.<br>Learning Objectives: Aim of this module is to provide a setting for advanced scientific discussion and debate in small groups about current ecological research challenges that are related to ecosystem functioning. The research question that is agreed upon under supervision is then addressed by data collection in the field and follow-up data analysis and paper writing.<br>Participation criteria & registration: Participation is by choice of the lecturers; Knowledge in plant ecology, R, statistics. Remote sensing skills and GIS are recommended.<br>A motivation letter needs to be uploaded in E-Learning until 06.11.2024<br>Exam registration: This module is offered annually in the summer semester and is meant to be completed within this term. However, the preparation phase starts at the end of the winter term before. The teaching language of this module is English. |
| 20732 | Analytical Microscopy in Geomicrobiology and Environmental Science | 4 | Le & Tu | 5 | |
| 20777 | Chromatographic Methods for Environmental Tracer Studies | 5 | Le & Tu | 5 | This module introduces analytical techniques using standard liquid and gas chromatographic methods tuned and applied for environmental organic tracer analysis.<br>Learning Objectives: This module aims to train the students on chromatographic methods. After this training, the students have understood the fundamental measurement principles, will be able to tune and run different chromatographs, and can quantify trace compounds from environmental, in particular atmospheric, samples.<br>Teaching methods: The course is structured into four parts, each handling a different instrument: TD-GC-FID, GC-MS, HPLC-UV, HPLC-MS. Each part begins with a theoretical lecture introducing the basic measurement principle, environmental applications of the techniques, and the first steps for running the methods. Then, the students' experimental and analytical skills are trained on the instrument. This includes standard procedures for running and tuning the instruments, quality control, standard preparation and sample runs as well as data analysis.<br>Recommended prior knowledge: WV01, WV30 and WV31 are recommended. As the number of participants is limited, the attendance and grades of these prerequisites will be used as selection criteria. |
| 20817 | Trends in quantitative ecosystem research | 2 | Se | 2 | Ecological publications with a focus on methodological advancements.<br>Learning Objectives: Participants will be able to understand and critically discuss current theories and concepts of ecosystem research as well as the methods and new methodological developments of ecological analysis, e.g., related to statistics, population modeling, range models, forest ecology, ecosystem monitoring, model-data integration, and meta-analyses.<br>Teaching methods: Seminar-style<br>Recommended prior knowledge: None<br>Examination mode: Successful participation in the module is achieved through a presentation as well as active participation in the seminar (ungraded). |
| 20832 | Lecture RNA - Structure and Function | 2 | Le | 9 | |
| 20833 | Seminar RNA - Structure and Function | 2 | Se | 9 | In the seminar, current and relevant works from the literature that are related to the lecture are presented by the students and discussed in the group. Attention is paid to a scientifically critical approach to the results.<br>Recommended prior knowledge: This module is designed to give students a detailed insight into the world of RNA. For decades, this biologically essential molecule was regarded as a mere intermediary in the central dogma of molecular biology. It is only in the last 20 years that interest has increased due to groundbreaking research, particularly in the field of long non-coding RNA (lncRNA). The aim is to convey that a structure-function relationship is important in RNA research in order to understand the action of these molecules. Knowledge about the influence of RNA molecules in all molecular mechanisms of the cell should be acquired and the critical handling of scientific literature and data should be practiced. In particular, students will learn the modern approach to RNA structure calculation and its special position in comparison to protein structure calculation. |
| 20834 | Practical course - RNA - structure and function | 5 | Int | 9 | In the practical course, the difficulties in RNA research will be demonstrated and how these can be overcome. First, RNA is produced, biophysically examined and structurally characterized. In addition, protein-RNA interactions are investigated biophysically and structurally.<br>Learning Objectives: This module is designed to give students a detailed insight into the world of RNA. For decades, this biologically essential molecule was regarded as a mere intermediary in the central dogma of molecular biology. It is only in the last 20 years that interest has increased due to groundbreaking research, particularly in the field of long non-coding RNA (lncRNA). The aim is to convey that a structure-function relationship is important in RNA research in order to understand the action of these molecules. Knowledge about the influence of RNA molecules in all molecular mechanisms of the cell should be acquired and the critical handling of scientific literature and data should be practiced. In particular, students will learn the modern approach to RNA structure calculation and its special position in comparison to protein structure calculation. |
| 21008 | Population ecology advanced seminar for B.Sc. and M.Sc. students, state examination candidates and doctoral students | 2 | Se | - | |
| 21521 | Symposium Global Environmental Challenges | 1 | Se | 5 | |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 21636 | Tutorial for Earth, Soil, Surface I<br>(B1/ÖLD2 Exercise Earth, Soil Surface I/Process Geomorphology) | 2 | Tu | 5 | The basic concepts of geomorphology are presented, followed by qualitative and quantitative investigation approaches in process geomorphology (e.g. mapping, mass flux measurements, surface models, shallow geophysics).<br>In the practical part of the module students learn to apply a selection of the presented techniques to geomorphological problems and to assess their possibilities and limitations.<br>The exercise is complementary for MSc students of Environmental Geography that participates at "B1 Earth, Soil Surface I" and MSc students of Geoecology participating at "ÖLD2 Process Geomorphology".<br>The practical part will take place in the second half of February 2025; the exact date will follow shortly. It will be two 2-day block field and data analysis exercises.<br>Examination mode: report. |
| 21645 | Fundamentals of Physical Chemistry for Electrochemical Energy Storage Systems | 2 | Le | 5 | |
| 21646 | Electrochemistry 1 | 2 | Le | 5 | The lecture will cover the following topics:<br>- Intro & Overview of Electrode Processes<br>- Potentials and Thermodynamics of Cells<br>- Kinetics of Electrode Reactions<br>- Mass Transfer by Migration and Diffusion<br>- Double-Layer Structure and Adsorption<br>- Basic Potential Step Methods<br>Learning Objectives: Acquiring competence in the field of electrochemistry.<br>Specifically, by the end of this course students should be able to:<br>- Demonstrate how the electrochemical potential and chemical equilibria define the thermodynamic potential for an electrochemical reaction;<br>- Discuss the validity and shortcomings of the Butler-Volmer equation to describe electrode kinetics; and be familiarized with alternate theories for combinations / derivations thereof);<br>- Understand and discuss the role of charge and mass transport in electrochemical systems;<br>- Attain a general understanding of what happens (in terms of e.g. measured currents, concentration gradients, diffusion limitations, among others) when an electrochemical cell is pushed out of equilibrium via a step in the potential.<br>Recommended literature:<br>- Electrochemical Methods, Fundamentals and Applications, 3rd Edition, Bard, Allen J. / Faulkner, Larry R. / White, Henry S. (ISBN: 978-1-119-33406-4)<br>- Electrochemical Methods: Fundamentals and Applications, 2nd Edition, Allen J. Bard, Larry R. Faulkner (ISBN: 978-0-471-04372-0)<br>Exam registration: February 2025, registration for the exam available until January 31, 2025<br>Examination mode: Written examination (90-120 minutes) OR oral examination (20-40 min). The precise type of examination will be communicated at the start of the semester.<br>Examination frequency: 1 per semester<br>Estimated student workload:<br>Lecture: 30 hours<br>Preparation and follow-up: 30 hours<br>Exercises: 15 hours<br>Exam preparation: 75 hours |
| 21647 | Electrochemistry 1 | 1 | Tu | 5 | |
| 22431 | Genetic engineering | 2 | Se | 9 | This course is compulsory for students of the BSc Biochemistry program (usually in the 5th semester). BSc Biology students can also apply for the module as a specialization module. Self-enrolment on the elearning platform for the course is possible from now until October 21, 2024, initially without an enrolment key. A preliminary discussion on the module will take place on Thursday, October 17, 2024 at 9:15 a.m. in lecture hall H11.<br>Please note the documents "Gentech2425_Readme 01" and "Signature Copyright" deposited on elearning. The latter must be completed, signed and sent to us by email-attachment or regular mail. |
| 24004 | Lecture Advanced Polymers (Biofabrication) | 2 | Le | 5 | |
| 24053 | Time Series Analysis | 2 | Le | 5; 8; 10 | Time series are ubiquitous in environmental sciences. In this course you will learn the basics of time series analysis. This course is open to all interested students, in particular in geoecology, GCE, biodiversity and ecology, environmental computer sciences and geography.<br>Our main topics are:<br>-Analysis of trend and seasonality<br>-Auto- and cross-correlation<br>-AR, MA, ARMA, ARIMA and FARIMA processes<br>-Long memory and Hurst coefficient<br>-Fourier transform<br>-Spectral analysis<br>-Wavelets<br>-possibly PCA/ SSA<br>Teaching methods: lecture and computer exercises<br>Recommended prior knowledge: good knowledge of R and statistics |
| 24054 | Time Series Analysis | 3 | Int | 5; 10 | Practical course after the lecture Time Series Analysis (74054)<br>Teaching methods: Data analysis on computer<br>Recommended prior knowledge: Introduction to R, lecture Time Series Analysis (74054) |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 24175 | Electrochemical energy systems and materials (C103) | 2 | Le | 5; 7; 9 | |
| 25789 | Fundamentals of Scientific Programming for Electrochemical Energy Storage Systems | 2 | Le | 5 | -Basics of Programming: Data types, control flow, functions, objectoriented programming, compiled vs. interpreted languages;<br>- Implementing Scientific Algorithms: Code structure, libraries, and performance optimization;<br>- Basics of High-Performance Computing: Parallelization, data management, benchmarking of program performance;<br>- Applied Programming in Python: Package management, visualization and data analysis, independent realization of programming projects related to the simulation and analysis of battery materials.<br>Learning Objectives: This course aims to give students an overview of basic concepts and tools of scientific programming as they pertain to the design, optimization and analysis of electrochemical energy storage systems and the underlying materials. Skills and concepts acquired in the lectures will be deepened in the accompanying exercises.<br>Examination mode: written exam |
| 25873 | Ecology and Evolution of Trait Plasticity | 2 | Le | 5 | |
| 25875 | Ecology and Evolution of Trait Plasticity | 3 | Tu | 5 | |
| 28004 | Micrometeorological and atmospheric chemistry seminar | 2 | Se | 5 | |
| 28008 | Agroecological graduate and doctoral seminar | 2 | Se | - | Talks and poster presentations by members of the agroecology group |
| 28013 | Introduction to Environmental Geochemistry and Geochemical Modeling | 4 | Tu | 5 | As part of an introduction, the main thermodynamic principles (mass action law, Henry's law) will be repeated and one of the most commonly used computer programs for hydrogeochemical modeling (PhreeqC) will be explained. Students will then work on practical examples, for which the chemical bases will be repeated briefly in the group before each student carries out calculations, interpretations, and predictions on its own. Afterwards, results will be compared and discussed within the group. The examples range from calculation of thermodynamic equilibria (e.g. modeling the buffer capacity of limestone for acid mine waters, the effects of reactive iron barriers, or measures of drinking water treatment), to modeling of kinetic processes (e.g. tritium degradation in the unsaturated zone or biodegradation) to modeling of one-dimensional and three-dimensional reactive mass transport.<br>Learning Objectives: Students refresh their basic chemistry knowledge and learn to apply it for explaining environmental chemistry processes in the air, soil, and water. Independently working on practical examples, students increase their chemical understanding of processes and learn to apply, test, and evaluate different solution approaches.<br>Teaching methods:<br>active participation in 2 courses: 60 hrs<br>preparation and follow-up: 45 hrs<br>performance assessment: 45 hrs<br>Total: 150 hrs. |
| 28021 | Current topics in environmental geochemistry | 2 | Cs | - | |
| 28128 | Mass Spectrometry | 4 | Cs | 5 | Students will learn the theoretical basis of mass spectrometry based on a textbook. Each chapter will be read prior to a seminar by each participant, then discussed in the group and completed by the lecturer in the seminar. In the accompanying tutorials, students are introduced to tuning, analysis and data interpretation as well as to trouble shooting and instrument maintenance. As an applied example, students then receive real samples in a difficult matrix (e.g., sewage sludge or sea water) and must independently carry out sample preparation, analysis and data interpretation including quality control and error calculations and they must evaluate their results in an environmental chemistry context.<br>Teaching methods:<br>active participation in 2 courses: 60 hrs<br>preparation and follow-up: 45 hrs<br>performance assessment: 45 hrs<br>total: 150 hours<br>Recommended prior knowledge: C2 must be successfully completed, C4 must be attended.<br>Other details: Further details on the exact schedule will follow here and be discussed during the first meeting. |
| 28440 | Modeling Land Use Policies, Markets, and Ecosystems | 2 | Tu | 3; 5; 10 | In this exercise, we will model land use decisions based on market development, agricultural and environmental policy in different case study regions.<br>Using agent-based modeling (in NetLogo), existing models will be adjusted and parameterized. This modeling approach allows the identification of probable land use decisions by individuals. Changes in ecosystem services through land-use decisions can be integrated into the decision-making process. Subsequently, consequences for the design of policy measures and the provision of ecosystem services are analyzed and evaluated.<br>Learning Objectives: Global and regional changes in land use policies and markets such as agricultural payments and food price changes can have substantial impacts on ecosystems. The lecture will give you insights in the interplay between these different drivers and resulting land use patterns. This will allow us to discuss the potentials of political action for sustainable management of ecosystems. |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 28131 | Environmental Analytical Chemistry II – Advanced Methods | 4 | Cs | 5 | The lecture introduction to Environmental Analytical Chemistry II will continue where module C2 ended. It will focus on advanced laboratory methods, getting into more details, mainly of chromatographic and spectroscopic methods. The tutorial will focus on selected topics of current research interest and include both practical laboratory work, e.g. development of a chromatographic separation method for trace elements by IC-ICPMS, but also detailed digital data interpretation, e.g. of results from optical measurements of natural organic matter or of XAS spectra from trace element binding to solid mineral phases. The tutorial will also include visits to other laboratories at University of Bayreuth to get an overview of available techniques as well as one visit to an analytical facility outside University of Bayreuth, such as e.g. the environmental research center Leipzig-Halle. The visits will be scientifically prepared by studying and discussing research papers of the respective groups.<br>Learning Objectives: Students get deeper insights into advanced analytical techniques used in modern environmental chemistry. Based on elaboration of selected topics in hands-on laboratory experiments and computer work, students will collect valuable experience for independent work in environmental analytical chemistry. Students will also learn about availability of advanced analytical methods inside and outside of University of Bayreuth.<br>Teaching methods:<br>active participation in 2 courses: 60 hrs<br>preparation and follow-up: 45 hrs<br>performance assessment: 45 hrs<br>total: 150 hrs<br>Recommended prior knowledge: C2 must be successfully completed |
| 28135 | Global Urban Health | 2 | Se | 5 | |
| 28301 | Micrometeorology: Micrometeorological Basics (Introduction to Micrometeorology) | 2 | Le | 5; 6; 9; 12 | |
| 74023 | Disturbance Ecology | 2 | Le | 3; 5; 9; 10; 15 | At the conclusion of this module, students will comprehend how ecosystems in all biomes are affected by natural and anthropogenic disturbance regimes, which create their own dynamics and spatio-temporal phenomena. This knowledge will enable participants to understand the effects of disturbances and extreme events on biodiversity and ecosystem functions, regeneration dynamics, and mechanisms of stability such as functional resilience.<br>Learning Objectives: At the conclusion of this module, students will comprehend how ecosystems in all biomes are affected by natural and anthropogenic disturbance regimes, which create their own dynamics and spatio-temporal phenomena. This knowledge will enable participants to understand effects of disturbances and extreme events on biodiversity and ecosystem func-tions, regeneration dynamics, and mechanisms of stability such as functional resilience. |
| 28407 | Biogeochemical methods in hydrology: Introduction to Aquatic Biogeochemistry | 2 | Le | 5; 9; 10 | This course will be taught by Dr. Clara Martínez-Pérez.<br>Introduction and Overview: This course aims to provide an in-depth understanding of biogeochemical processes in complex environmental systems, specifically focusing on lake systems. It combines theoretical knowledge with practical skills, enabling students to conduct biogeochemical research through field investigations and laboratory analyses of lake water and sediment samples. Students will gain a conceptual understanding of biogeochemical processes and learn practical techniques to sample, measure, and interpret biogeochemically relevant compounds at different spatial scales in aquatic systems. The course aims to contextualize limnological theory practically, facilitating a field-based approach to understanding lake functioning and applying this knowledge to lake systems beyond those studied.<br>Course Content:<br>Limnological Techniques in the Field<br>- A range of freshwater sampling techniques, including water column and porewater sampling.<br>- Measurement of physicochemical parameters, with an emphasis on oligotrophic vs. eutrophic systems.<br>Biogeochemical Cycling in Lake Systems<br>- Focus on redox processes and nutrient cycling in the water column and sediments.<br>- The significance of these processes for water quality and ecosystem health.<br>Coupling Between Physical and Biogeochemical Processes in Lakes<br>- The importance of stratification on chemical processes.<br>- Exploration of natural chemical reactions and the dynamics of open vs. closed systems.<br>Learning Objectives: Course Structure:<br>The course alternates between theoretical concepts and practical activities, progressively leading to an inquiry-based task. This task will encompass various aspects of scientific research, including selecting variables, planning data collection, analyzing data, assessing data quality, dealing with unexpected results, postulating mechanisms, representing data, and communicating results. By the end of the semester students will design a sampling strategy for a local lake. The skills gained will enable students to characterize the state of a system over space and time in both equilibrium and dynamic conditions.<br>Participation criteria & registration: Language: English (due to integration into the MSc Environmental Chemistry)<br>Enrollment: Maximum 10 students. Please enroll on cmlife.<br>Schedule: Every Friday from 10:00-12:00, with a field/lab intensive session at the end of the winter semester/start of the summer semester. Date TBD.<br>M.Sc. Enviromental Chemistry: W3; M.Sc. Geoecology: GM 3.15 (old PO); M.Sc. Geoecology: BGCP 10 |
| 28416 | Introduction to Aquatic Geochemistry | 2 | Le | 5; 10 | |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 28151 | Introduction to soil physics | 2 | Le | 3; 5; 10; 17 | This course provides an introduction to the main physical properties and processes of soil. Participants will learn which are the most important soil particles and how we can quantify them in the laboratory (theory only), soils as three-phase systems, what are the main forces acting on soil water, how water is stored and moves in soils and much more. The course is organized as a series of lectures and exercises.<br>The most important parts are:<br>-Introduction to soil physics<br>-Physical properties of soil<br>-Water properties and capillary rise<br>-Relationships between volume and mass<br>-Energy status of soil water<br>-Water retention in the soil<br>-Water flow in saturated and unsaturated soils<br>-Water flow under transient conditions<br>-Introduction to the transport of dissolved substances<br>Learning Objectives: Knowledge<br>1. knowledge of the most important physical properties of soils<br>2. learn the basic methods for quantifying the physical properties of soils<br>3. knowledge of the most important mechanisms/processes for water flow and solute transport in soils<br>Skills<br>1.master basic calculations for different laboratory methods<br>2.Master basic calculations for the most important equations describing water flow and solute transport in the laboratory and at the field scale<br>Skills<br>1. identify and determine essential soil physical properties and processes with regard to soil hydrology, hydrology, ecohydrology, soils as ecosystem services, soil quality<br>2. interpret experimental data and draw appropriate conclusions.<br>3. evaluate the soil as a growth medium for plants<br>4. assess how the physical properties of soil influence (or are influenced by) chemical and biological processes<br>Teaching methods: Class teaching with active participation of students through theoretical exercises, discussions, group work.<br>Lecture: 60-70%<br>Exercises: 30-40%<br>No lab part for this course.<br>Expected workload: 75 h (including time spent in class)<br>Recommended prior knowledge: No prior knowledge is required.<br>Participation criteria & registration: No criteria apply<br>Examination mode: written exam<br>Other: creditable for UP3 for Bachelor's degree program Physics with focus on Environmental Physics |
| 28417 | Methods in Aquatic Geochemistry | 2 | Tu | 5; 10 | This tutorial can only be attended together with the lecture "Introduction to Aquatic Geochemistry". Please refer to the course page for the "Introduction to Aquatic Geochemistry" lecture for further information. |
| 28420 | Carbon and water budgets from ecosystem to landscape scale (Models in Micrometeorology) | 2 | Se | 3; 9; 10 | |
| 28556 | Statistical analysis of geoscientific data | 2 | Tu | 5; 6; 9; 10 | The course deals with the acquisition, processing, statistical evaluation and use of geoscientific raster datasets (NetCDF, multi-layer GeoTIFFs) and thematic point information (station values, field data). The main focus is on climate data (e.g. GPCC, ERA5). Time series, simple trends and applied facts are examined and various data sets are evaluated. In addition, climate and environmental information is clearly visualized. The basis for this is the software R/R Studio. QGIS is also used for visualization.<br>Recommended prior knowledge: Basic knowledge of R is desirable. ATTENTION: for the first use of the course software on the PC pool computers it is necessary to fill out the following form for the course software GEO: www.intranet.uni-bayreuth.de/de/intranet_its/raeume-und-ausstattung/PC-Pools |
| 28614 | Current issues of global change | 2 | Se | 2; 5; 6; 9; 10; 12 | The topic of global environmental change is highly topical and is becoming increasingly important in public discourse. The first part of this course takes up the most important topics in this regard, discusses scientific contexts and the current state of research. Methodologically, media contributions and specialist publications are linked and discussed. The second part will focus on measurements and observations of global environmental changes. |
| 28668 | Multivariate statistics (introduction to R) | 2 | Tu | 6; 9 | In this course we will deal with the basics and selected applications of the programming language R for the purpose of data analysis in human geography research. No previous knowledge of programming or similar is required, basic knowledge of descriptive statistics is an advantage.<br>In the sessions we will work together on the different steps of data analysis and deepen these through practical exercises. These steps include reading, modifying, evaluating, visualizing and saving (geo)data as well as work documentation for exchange with third parties.<br>The aim of the course is to enable students to work independently with R and to prepare them for advanced applications. It is recommended that students install R and the RStudio development environment on their own computer (see https://posit.co/download/rstudio-desktop/).<br>The required performance includes regular and active participation in the sessions as well as their preparation and follow-up and a final data evaluation in the form of a short project report.<br>Recommended prior knowledge: See module handbook for Bsc Geography.<br>For Msc Urban and Regional Research. No prerequisite.<br>Recommended reading: Wickham H, Çetinkaya-Rundel M and Grolemund G. 2023. R for Data Science. Second edition. Sebastopol: O'Reilly. https://r4ds.hadley.nz |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 28910 | Socio-economic Development Processes | 2 | Ad. Se | 2; 3; 6; 10; 12 | |
| 28911 | Regional Geography: Africa/Asia/Latin America | 2 | Se | 5 | This module introduces students to fundamental concepts, critical debates, and epistemological concerns in regional geography. It focuses on physical geography, demographic patterns, human and economic resources, socio-political systems, and their interrelationships in the global south (Africa, Asia and Latin America) and its relationship with the rest of the world. Furthermore, it challenges the boundaries and rigid categorizations of world regions as nothing more than constructions of colonial and imperial powers and predatory practices of epistemic communities in knowledge production. While the de-/anti-colonial scholarship brings a certain epistemic emancipation in current regional geography studies, it is still essential to interrogate the historiography of traditional and contemporary regional geography to interrogate regional geography literature and the scientific rigor of established pedagogical approaches.<br>The 'traditional regional' geography entails the study and collection of 'homogenous' features, including 'natural' characteristics (e.g., forests/desert landscapes and water bodies) and 'man-made' versions (e.g., the built environment, ideologies, system of government and cultures) characterizing specific areas of the earth, called a 'REGION'. The synthetic view of the world provided the basis for studying and analyzing spatio-temporal variations in poverty, economic development, religion, political systems, and human-environment interrelations. However, the traditional 'regional geography' has given way to a 'new regional geography', emphasizing the dynamic, relational and interconnected nature of regions. This approach considers how regions are transformed, institutionalized, and developed through regionalization, region-building, and the construction of regional identities. The mutability of features characterizing 'Regions' and current conceptions of regions as relational and temporary entities challenge or expose the limits of conventional geographical categorizations (e.g., Developed, Developing, Underdeveloped World and recently 'Global South'/Global North' labelings). The module, therefore, engages with the following questions: Why is the synthetic view of the world giving way to new perspectives treating regions as relational and temporary assemblages along which regions are institutionalized and transformed? How do history and globalization processes intersect with and remake regional geographies of Africa, Asia and Latin America? How can we overcome existential gaps in regional geography literature or tie loose ends in established pedagogical approaches? Which theoretical perspectives offer a better understanding of these three regions in the context of global change and increasing regional interconnectedness?<br>Learning Objectives: I<br>Recommended literature: See E-Learning course<br>Examination mode: To ensure a comprehensive understanding of the Regional Geography Module, each student MUST answer one of four examination questions. The Home Exam Essay is an excellent opportunity for students to showcase their critical thinking through a review report that offers a unique perspective on a fundamental debate. The essay should be at most eight pages (excluding references), and students should strive to demonstrate their in-depth knowledge of the thematic issues featured in the module. The essay should be well-structured, with a clear introduction, body, and convincing conclusion. |
| 28922 | Global land use change (Global Land Use Change) | 2 | Se | 3; 4; 5; 6; 8; 9; 10 | Land has been transformed into a resource since the dawn of *mankind*. This transformation has led to diverse economic and socio-ecological landscapes throughout human history, but land-use change has taken on drastic, global proportions with the rise of capitalism as a globe-spanning socioeconomic and socioecological system. In this seminar, we will discuss the history; drivers; spatial patterns; vectors (often referred to as telecouplings); and social, economic, and environmental outcomes of land-use change. Global supply chains will be one of the key vectors we look at for investigating land-use change at a global and local scale. Supply chains make the world go round. But what are the environmental costs attached to global supply chains?<br>We combine a global-historical perspective with a case study approach. We will also put an emphasis on different methods of visualizing and tracking land-use change, from above (a data-driven macro-view) as well as from below (an actor-centred perspective). Lastly, we deal with the issue of land-use governance and how to counter the economic, social and environmental fallout of capitalist land-use models. The seminar is held in English.<br>Participation criteria & registration: Max. 20 participants possible.<br>You can still register for this course by sending an email to the lecturer: Leiyo.Singo@uni-bayreuth.de |
| 60059 | Advanced polymer materials in batteries | 2 | Le | 5 | The lecture teaches:<br>-Brief history of polymers and batteries, working principle of batteries and relevant KPIs;<br>-Nomenclature and definitions: P_n,M_w,M_n, MWD, polymer topology, single chain models, chain conformation, ideal chain, Kuhn-segments, real chains;<br>-Polymerization methods: step growth polymerization, chain growth polymerization, controlled methods (AROP, RAFT, ATRP); - Polymer examples: industrially relevant polymers, high performance polymers, and specialty polymers;<br>-polymer architectures: copolymers, stars, brush polymers, block copolymers;<br>-polymer nanostructures: Flory Huggins theory, self-assembly, microphase separation, templating;<br>-Analytical methods: SEC, DLS/SLS, SAXS, TEM, SEM/EDX;<br>-Electrode coatings, solid electrolyte interface and additives;<br>-Solid polymer electrolytes: examples, properties, in-situ polymerization;<br>-Organic electrodes: examples for redox-active organic molecules and polymers, their synthesis, processing, and properties, as well as applications of organic batteries;<br>-polymer recycling: metrics about plastic production and waste, recycling concepts and future perspectives biological and bio-based alternatives.<br>Learning Objectives: The objective is to learn about the development and use of advanced polymer materials for next generation batteries. The lecture gives an overview of challenges and opportunities for polymers as binders, polymer nanostructures and templates, solid polymer electrolytes, and as active material (organic electrodes). |
| 60060 | Advanced polymer materials in batteries | 1 | Tu | 5 | |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 68026 | Scientific workshop for Environmental Geography | 5 | Pj | 5 | |
| 74001 | Global Change Ecology (Oa) | 1 | Le | 5; 9 | First, an overview of the information about current and expected global development is given. Not only climate change but also land-use changes and the loss of biodiversity is included. In the advanced seminar, current research results are presented and analyzed.<br>Learning Objectives: This module lasts for one semester and must be taken in the first semester as it sets the basis for the entire program. The course consists of a one-hour lecture and a one-hour seminar. Additionally, a regularly scheduled weekly meeting is offered to discuss current study issues and for group mentoring. Two daylong excursions about landscape ecology supplement the module.<br>Miscellaneous: 16.10.24 Introduction to seminar and interactive part "Global Change Ecology" |
| 74002 | Progress in Global Change Research | 1 | Se | 5; 9 | First, an overview of the information about current and expected global development is given. Not only climate change but also land-use changes and the loss of biodiversity is included. In the advanced seminar, current research results are presented and analyzed<br>Learning Objectives: This module lasts for one semester and must be taken in the first semester as it sets the basis for the entire program. The course consists of a one-hour lecture and a one-hour seminar. Additionally, a regularly scheduled weekly meeting is offered to discuss current study issues and for group mentoring. Two daylong excursions about landscape ecology supplement the module. |
| 74003 | Jour Fixe | 1 | Se | 5 | The module provides an overview of current and anticipated global developments, addressing not only climate change but also land-use changes and the loss of biodiversity. In the advanced seminar, participants will present and analyze recent research findings.<br>This module spans one semester and is mandatory in the first semester, as it lays the groundwork for the entire program. The course structure includes a one-hour lecture followed by a one-hour seminar. Additionally, there is a weekly meeting designed for discussing ongoing study issues and providing group mentoring. To enhance learning, two full-day excursions focusing on landscape ecology are included in the module. |
| 74004 | Excursion | 1 | Ecn | 4; 5; 6 | First, an overview of the information about current and expected global development is given. Not only climate change but also land-use changes and the loss of biodiversity is included. In the advanced seminar, current research results are presented and analyzed.<br>Participation criteria & registration: GCE O Module<br>Other Modules: Excursion to Bamberg 18.10.24, Start at 8 am at the parking lot of GEO building. |
| 74006 | Natural Climate and Human Impacts on Climate | 2 | Le | 5; 9 | Learning Objectives: The aim of this module is to teach fundamental knowledge about current climate development.<br>Course Content: Basic principles of the climate system; naturally-occurring climate variability, climate change in the past; reconstruction of past climate; natural forcing-factors, circulation dynamics; human impact on the climate system; global warming; Greenhouse effect; land use change; aerosols; ozone depletion; global circulation models; forecasts; scenarios; fundamentals of energy and mass balance; modelling; sensitive parameters of global change |
| 74007 | Climate Variability and Change:<br>Natural and Man-Made | 2 | Se | 5; 9 | Basic principles of the climate system; naturally-occurring climate variability, climate change in the past; reconstruction of past climate; natural forcing-factors, circulation dynamics; human impact on the climate system; global warming; Greenhouse effect; land use change; aerosols; ozone depletion; global circulation circulation models; forecasts; scenarios; fundamentals of energy and mass balance; modeling; sensitive parameters of global change |
| 74010 | Natural Risks and Hazards | 2 | Le & Tu | 3; 5; 6; 9; 10 | Aim of this module is to teach about occurrence and impact of natural risks and extreme events in ecology. Reoccurring events are included as well as single disasters; those with stabilizing effects and those with catastrophic consequences and regime shifts. The impact of climatic, biotic and geomorphological events on biodiversity, ecology, provision of services, and cultural landscapes is covered. The learning objective is the ability to deal with in-depth theories and methods of Disturbance Ecology and to research extreme events. Fundamentals for a scientific study of interdisciplinary disaster research and risk management will be developed.<br>There is no ecozone, no ecosystem, no part of our natural enviroment without disturbances. The variety of potential disturbance events and disturbance regimes on our globe range from such extreme events as volcanic eruptions and tsunamis to small-scale events such as insect herbivory or the invasion of neophytes and neozoos. In this seminar, we will walk through the Earth's ecozones in different thematic blocks and introduce the typical disturbance regimes.<br>There will always be a short keynote presentation by the two course instructors at the beginning of each block topic. Afterwards, students will have the opportunity to give their presentations and discuss them. The presentations should not exceed 15 minutes. There will be 5 minutes for discussion. Attentive and active participation in the discussions is required from all participants, as this will be included in the overall grade.<br>There will be a list of topics (see below), where you can choose *your* disturbance type for your presentation.<br>Learning Objectives: We have prepared various presentation topics and offer them for selection. Each person chooses a topic from the list (first come first serve) or you have your own idea for a topic that fits the given list. The list is available here as a pdf. However, all participants are expected to sign up for the list that hangs on the concrete pillar outside our office (room 016.2; to the right of Anke's office). You can also come to our office if you have any questions. (Andy & Svenja)<br>Teaching methods: The presentation should not exceed 15 minutes in order to allow for a few minutes of questions and discussion. All presentations should be delivered in the form of ppt and pdf files. The pdf files are then available to all for post-processing. Therefore, please do not include too many animations. |
| 28913 | Development Cooperation / Development Planning | 2 | Exe | 2,4; 6; 10 | Participation criteria & registration: Dev. Studies in Geography (Bordeaux - Double Degree) |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 74012 | Hydrological Concepts | 2 | Le | 3; 5 | |
| 74020 | Development and Change of Biodiversity | 2 | Le | 5; 9; 10; 15 | Through global climate change, pollution, land-use, invasive species, spread of diseases and linking across continental barriers biodiversity is facing severe impacts and losses with consequences on ecosystem functioning. Biogeography is undergoing great changes, as more and more questions about complex relationships on a global scale are addressed. This rapidly growing field of expertise and new findings will be scrutinized in case studies.<br>Learning Objectives: The aim of the module is to learn about development and distribution of the variety of life on earth. Students learn about the spatial features of organisms and biotic communities on different spatial scales. The role of biodiversity for a functioning ecosystem will be discussed along with global change and its impact. The lecture deals with the evolution of variety on earth, prior major extinctions, the significance of the variety of ecosystem functions and current trends.<br>Participation criteria & registration: This course is part of a module and has been moved from the winter to the summer semester 2024. Only for those students who have already completed the first part (Progress in Biogeography) of the module in winter.<br>This course is offered as a block course at the beginning of the summer semester.<br>The qualification to C2 is made possible, you can take this module despite the block course still to come. |
| 74021 | Progress in Biogeography | 2 | Se | 5; 6; 9; 12 | Through global climate change, pollution, land-use, invasive species, spread of diseases and linking across continental barriers biodiversity is facing severe impacts and losses with consequences on ecosystem functioning.<br>Biogeography is undergoing great changes, as more and more questions about complex relationships on a global scale are addressed. This rapidly growing field of expertise and new findings will be scrutinized in case studies.<br>Learning Objectives: In the seminar, current developments in Biogeography are addressed. The aim is to inform about current trends in biogeographical research. Novel methods and approaches are analyzed and discussed. Students gain practice in working with current literature platforms and online journals. Putting together and presenting a presen-tation trains students in the production of reviews and survey articles based on the progress in current scientific primary literature. |
| 74043 | Research at the Natural and Social Science Interface | 1 | Se | 1; 2; 5 | This course teaches theory and practice of inter- and transdisciplinary research.<br>Learning Objectives: Environmental problems require not only expert knowledge but also the ability to work together with different disciplines and societal actors. The aim of this module is to impart knowledge about the interface in inter- and transdisciplinary research. The possibilities and limits of these approaches are conveyed using examples. |
| 74024 | Stability, Resilience and Inertia | 3 | Se | 3; 5; 9; 10 | Theory, methodology and application of disturbance ecology and pulse dynamics as well as the relationship between disturbance, vegetation dynamics and ecosystem functions are taught in the lecture "*Disturbance Ecology*". Current research frontiers in disturbance ecology, resilience and sustainability science are presented and discussed in the seminar "*Resilience*". The significance of understanding disturbance ecology for ecosystem restoration and sustainable land-use planning is also addressed. Temporal variability of ecosystems, their rhythms and recurrent events are discussed with respect to future global changes to assess the dynamics of ecological systems. |
| 74025 | Spatial Ecology | 2 | Se | 5; 6; 9; 12 | The seminar works with examples of ecological spatial phenomena (e.g. source-sink dynamics, metapopulations, invasions, coexistence).<br>Learning Objectives: Spatial processes play an important role in ecology, e.g. for the persistence of single populations, expansion of invasive species or preservation of species diversity.During this module, students should develop a problem-oriented understanding for the essential spatial processes like expansion and they should also develop skills to apply and develop dynamic models.<br>Participation criteria & registration: Knowledge in programming language R<br>Basic knowledge about ecological processes and models<br>M4 Foundations of Biogeographical Modeling (recommended) |
| 74026 | Modeling of Spatial Ecological Processes | 2 | Tu | 5; 9; 10 | The exercise covers numerical simulations of spatial processes (e.g. cellular automaton models, species distribution models). The relevant modeling approaches will be applied and discussed.<br>Learning Objectives: Spatial processes play an important role in ecology, e.g. for the persistence of single populations, expansion of invasive species or preservation of species diversity.<br>During this module, students should develop a problem-oriented understanding for the essential spatial processes like expansion and they should also develop skills to apply and develop dynamic models.<br>Participation criteria & registration: Knowledge in programming language R<br>Basic knowledge about ecological processes and models<br>M4 Foundations of Biogeographical Modeling (recommended) |
| 74033 | Climate Policy and Instruments | 2 | Se | 5 | |
| 74058 | Life Cycle Assessment of Products | 2 | Tu | 2,5; 9 | |
| 74059 | Scientific writing in biogeography and disturbance ecology (Scientific Working) | 1 | Se | 1; 2; 5 | Different trans-disciplinary manuscripts, both in content and methods, are offered, reviewed and discussed in small groups.<br>Learning Objectives: The basic principles of scientific writing and publishing will be taught. In par-allel, the students will be able to understand and discuss recent theories and concepts of Biogeography and Disturbance Ecology and deal critically with these. Furthermore, personal and social-communicative competencies in the sense of in-dependent development, evaluation and presentation of research topics will be trained intensively in small groups.<br>Participation criteria & registration: This course is mandatory for students of MSc Environmental Geography and is placed in the module A1 'Theories in Environmental Geography/Scientific Working'. The name for this course is 'Scientific Working' in the study guide of MSc Environmental Geography. |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 74034 | Climate Diplomacy | 2 | Se | 5 | In the first part of the lecture, economic criteria for determining efficient and fair climate policy goals are developed. Then climate policy instruments are dealt with (e.g. regulatory policy; CO2 tax; emissions trading) and instrument selection is discussed with imperfect information. In interactive phases, economic concepts are deepened along with current case studies, such as the German coal phase-out, national CO2 pricing (climate package) or European emissions trading (EU ETS).<br>In the second part of the module, an introduction into the climate regime (United Nations Framework Convention on Climate Change, Kyoto Protocol, Paris Agreement) in the context of international environmental governance will be given. This will be discussed against the backdrop of geopolitical developments.<br>Global environmental commons, Introduction into the International Climate Regime, Roles of state and non-state actors, Case Studies, Critical Assessment and Concluding Discussion.<br>Learning Objectives: After attending the lecture (i), students are familiar with various instruments for achieving climate policy goals, (ii) can analyze them in terms of efficiency, distribution effect and uncertainties, and (iii) are able to critically discuss the advantages and disadvantages of real-world political instruments along economic criteria.<br>The course will introduce key concepts such as the "*tragedy of the commons*" and "*collective action problems*", and discuss key academic developments in the understanding of the management of global commons. The course will ensure that the students develop a firm grasp of the fundamental dynamics of climate change negotiations while introducing the main legal instruments that form the backbone of the climate regime. Students will be able to critically assess how the Paris Agreement can mobilize action. |
| 74035 | Ecosystem Services | 2 | Le | 2; 5; 6; 9; 12 | The lecture gives an overview of ecosystem services in regional and global human-environmental systems. Contents include the definition and classification of ecosystem services, their relationship to biodiversity and the role of global change. Furthermore, the physical quantification and socio-economic evaluation, the supply and demand by social actors as well as the management of the performance of the ecosystem by market-related policy instruments are dealt with.<br>Learning Objectives: Global change in climate, land use, markets and politics has a major impact on the performance of ecosystems. The aim of this module is to examine in greater depth the ecosystem services relevant to societies (food production, erosion regulation, drinking water purification, risk protection, etc) and their relationship to biodiversity. |
| 74036 | Current Research in Ecosystem Services | 2 | Se | 5; 9 | The seminar deepens lecture topics with current examples from research.<br>Learning Objectives: Global change in climate, land use, markets and politics has a major impact on the performance of ecosystems. The aim of this module is to examine in greater depth the ecosystem services relevant to societies (food production, erosion regulation, drinking water purification, risk protection, etc) and their relationship to biodiversity. |
| 74046 | Land Use Policies, Markets, and Ecosystems | 2 | Le | 5; 6; 9; 12 | The lecture addresses the influence of markets and politics on land use change. With global and regional case studies, we will analyze the relationship between those drivers, local land use and management decisions, and the provision of ecosystem services. Additionally, we will get an overview of different methods for the quantification of land use change and affected ecosystem services.<br>Learning Objectives: Global and regional changes in land use policies and markets such as agricultural payments and food price changes can have substantial impacts on ecosystems. The lecture will give you insights in the interplay between these different drivers and resulting land use patterns. This will allow us to discuss the potentials of political action for sustainable management of ecosystems. |
| 74069 | Science and Communication | 2 | Le & Tu | 3; 10 | Science communication skills are needed to get support for scientific research, to inform decision-making, or to engage stakeholders. A major component of this course will be to provide students with the chance to apply knowledge acquired in previous modules to defend their envisaged solution to typical climate change or conservation challenges or discussions.<br>Learning Objectives: The course provides an overview of the challenges associated with scientific communication, especially science outreach typically conducted by scientists to non-expert audiences. At the end of this course, the students will have acquired a good understanding of the multiple factors shaping the success of different communication strategies and tools. Importantly, this course aims to help support the development of critical thinking and decision making among students, while enhancing their communication skills. |
| 74071 | Academic Working Methods and Skills | 2 | Le & Tu | 2; 10 | Literature data bases, structuring with Mind Map, visualization, organization of written and oral presentations (poster, talk), discussion phase, stage fright, body language, feedback, video analysis of presentations.<br>Learning Objectives: The aim of this module is to train students with hands-on experiences in academic working methods and skills. The participants gain an overview of the central steps in knowledge processing, beginning with the selection of suitable sources of information up to structuring content and preparing written reports and oral presentations. |

| Number | Course Title | Duration | Type | ECTS / Credits | Module Description |
|---|---|---|---|---|---|
| 74083 | Socio-Economic and Political Dimensions of Global Change | 2 | Se | 2; 5; 6; 9; 15 | We live in a world of change with all its concomitant adaptation mechanisms. The change is ubiquitous, hardly controllable and predictable. The observed changes entail dramatic and constant alterations in their impacts, geographical scope, and actors involved. It also consists of evolving perspectives on 'geographies of opportunities' or its antithesis (i.e. 'cursed geographies'). Examples of global change include climate change, resource depletion (or even threats of extinction), spatial spread of deadly diseases and their remediation measures, system-wide transitions (e.g., energy, agrarian, ecological, political and technological transitions), and new geographies of the transitions (e.g., energy transitions in the global south). Since adaptation and mitigation measures embody the making of 'desirable' planetary futures for everyone everywhere, global change is linked to the production of hegemonic discourses by powerful actors and epistemic communities that define, legitimize, or defy particular ways of envisioning and embracing global change and transformation. Furthermore, while specific forms of global change are not entirely new, their novelty lies in how they are represented, contested, and justified in new ways and geographies. Unequal adaptative capacities of individuals, social groups, communities and countries to change and power asymmetries in the control of hegemonic discourses suggest that global change produces opportunities/privileges interlaced with marginalization, uncertainties, resource access struggles and 'resource-making'. Framing these changes with the prefix 'global' suggests universal impacts and thus requires a systemic, radical, and all-inclusive approach. This GCE module interrogates environmental change orthodoxies and employs a political ecology approach to examine the nature and trajectory of political and socio-economic dimensions of global change.<br>Teaching methods: Seminar Presentation & Home Exam Essay Format<br>Students are required to make seminar presentations to discuss the content of selected scientific articles. Presentation groups shall be constituted during the introductory lecture (i.e. October 20, 2021) and scientific articles will be assigned to each group before the commencement of group presentations in the subsequent seminar sessions. The thematic issues for the course (see timetable below) and relevant literature will be uploaded on E-learning for your information. Student presentations may be done either in a regular presentation style or in the form of a role-play during seminar meetings. At the end of the course, students shall be required to submit Home Exam Essays for evaluation according to these grade marks (1.0, 1.3, 1.7, 2.0, 2.3, 2.7, 3.0, 3.3, 3.7, 4.0 & 5.0). Students who do not submit the final Home Exam essays are considered to have FAILED the course! Seminar presentations are required for participation in the course but DO NOT form part of the evaluation and grading of the final Home Exams.<br>Participation criteria & registration: Please note that attendance at all seminars is mandatory. Please be aware that missing up to three seminar sessions is strictly prohibited.<br>Students who fail to register for the course after the stated registration deadline will be asked to WITHDRAW from the system and take the class the following semester. Our Administrative Secretary, Mrs. Märkisch, will join us in our introductory seminar to clarify all registration issues. Mrs. Märkisch may be reached by email address: Tanja.Maerkisch@uni-bayreuth.de |
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**Key/Abbreviations:**

Ad.Se Advanced seminar
Cs Course
Le Lecture
Pj Project
Se Seminar
Tu Tutorial
Int Internship

**Please check availability of your chosen subject/course by contacting the respective faculty.**

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