Universität Bremen

Faculty 1 Physics/Electrical Engineering

Summersemester 26

Module Guide

for the study of

Natural Sciences for Sustainability

Bachelorstudiengang

valid in connection with the examination regulations BPO 2024

Generated: February 17, 2026

Anlage 1: Studienverlaufsplan des Bachelorstudiengangs „Natural Sciences for Sustainability“

Der Studienverlaufsplan stellt eine Empfehlung für den Ablauf des Studiums dar. Module können von den Studierenden in einer anderen Reihenfolge besucht werden, dazu wird eine vorherige Beratung dringend empfohlen.

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<tr><th colspan="2" rowspan="2"></th><th colspan="4">Foundations in Natural Sciences for Sustainability, 96 CP</th><th>Self-designed Project, 12 CP</th><th colspan="3">Schwerpunkt (Focus Area), 30 CP</th><th colspan="2">General Studies-Bereich (General Studies Area), 27 CP</th><th rowspan="2">Bachelor-arbeit (Bachelor Thesis), 15 CP</th><th rowspan="2">∑ 180 CP</th></tr>
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Eng1, Energy 1, 9 CP
Eco1, Ecology 1, 6 CP</td><td></td><td colspan="3"></td><td>FSW, Fundamentals of Scientific Work, 6 CP</td><td></td><td></td><td>30</td></tr>
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NatRes1, Natural Resources 1, 9 CP
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Eng2, Energy 2, 9 CP
NatRes2, Natural Resources 2, 6 CP</td><td></td><td colspan="3"></td><td>EnvEt, Environmental and Climate Ethics, 6 CP</td><td></td><td></td><td>30</td></tr>
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NatRes3, Natural Resources 3, 9 CP
OneHe, One Health, 6 CP</td><td></td><td colspan="3"></td><td></td><td>gemäß § 2 Absatz 1, 9 CP</td><td></td><td>33</td></tr>
<tr><td rowspan="2">3. Jahr</td><td>5. Sem.</td><td colspan="3"></td><td>ProInt, Self-designed Project, 12 CP</td><td>Focus Area gemäß Anlage 2.3, 6 CP</td><td>Focus Area gemäß Anlage 2.3, 6 CP</td><td>Focus Area gemäß Anlage 2.3, 6 CP</td><td></td><td></td><td></td><td>30</td></tr>
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CP: Credit Points, Sem.: Semester

Index by areas of study

1) Compulsory Modules (108 CP)

The compulsory modules comprise the areas "Foundations in Natural Sciences for Sustainability" and "Self-designed Project". All modules in these areas must be completed.

a) Foundations in Natural Sciences for Sustainability (96 CP)

b) Self-designed Project (12 CP)

2) Compulsory Elective Modules (30 CP)

Students must complete 2 out of 3 Focus Areas for a total of 30 credits, including one Focus Area for 12 credits and a second Focus Area for 18 credits.

a) Focus Area Physics (12 - 18 CP)

b) Focus Area Biology (12 - 18 CP)

c) Focus Area Geosciences (12 - 18 CP)

3) General Studies Area (27 CP)

General Studies Area of 27 CP, which includes the compulsory modules (12 CP) "Fundamentals of Scientific Work" and "Environmental and Climate Ethics" and the Elective Area (15 CP).

a) Compulsory Modules (12 CP)

b) Elective Modules (15 CP)

Up to two of the following elective modules and courses from the University of Bremen's General Studies Area can be chosen.

4) Bachelor Thesis (15 CP)

5) Additional Courses

Module 05-GW-BA-WatCy1: Water Cycle 1
Water Cycle 1

Assignment to areas of study:

- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:

Grundkenntnisse in Mathematik, Physik und Chemie

Learning content:

In diesem Modul werden durch inhaltlich aufeinander abgestimmte Lehreinheiten die Grundlagen des globalen Wasserkreislaufs erklärt und die thermodynamischen, statistischen und chemischen Hintergrundkenntnisse in angewandter Form vermittelt. Im Speziellen wird zuerst eine Einführung in die verschiedenen Teilsysteme des Wasserkreislaufs und die Phasenübergänge von Wasser gegeben. Danach wird die atmosphärische Komponente des Wasserkreislaufs näher vorgestellt, u.a. Dampf und Wolkenbildung, Kondensation und Niederschlag, Strahlungseigenschaften von Dampf und seinen natürlichen Treibhauseffekt. Des Weiteren wird auf die terrestrische Komponente des Wasserkreislaufs mit Teilaspekten wie Speicherung, Versickerung und Abfluss, Vegetation, Böden, Transpiration, Dürre und Desertifikation eingegangen. Zum Schluss werden das Konzept von ITCZ- und Hadley-Zirkulation und deren zeitliche Entwicklung und Effekte auf das globale Klima beleuchtet, bevor auf die Archive und Messmethoden eingegangen wird.

- Für die praktische Arbeit werden einfache Analysen von Dürren und Überschwemmungen (grundlegende Beschreibungen, Indizes, historische Veränderungen) durchgeführt und methodisch in Feldarbeiten an lokalen Gewässern erprobt.

In this module, the fundamentals of the global water cycle are explained through teaching units with coordinated content, while the thermodynamic, statistical and chemical background knowledge is taught in an applied form. In particular, the various subsystems of the hydrologic cycle and the phase transitions of water are being introduced first. A more detailed introduction to the atmospheric component of the water cycle follows, which includes vapor and cloud formation, condensation and precipitation, radiative properties of vapor and its natural greenhouse effect. In addition, the terrestrial component of the hydrologic cycle will be addressed including aspects such as storage, infiltration and runoff, vegetation, soils, transpiration, drought and desertification. Finally, the concept of the ITCZ and Hadley circulation, and their temporal evolution and effects on global climate will be explained followed by introducing archives and measurement methods.

For practical work, simple analyses of droughts and floods (basic descriptions, indices, historical changes) will be carried out, and methodically tested in field work on local water bodies.

Learning outcomes / competencies / targeted competencies:
Die Studierenden sollen eine umfassende Einführung in das multidisziplinäre Feld Wasserkreislauf bekommen. Dabei werden die Grundzüge des globalen Wasserkreislaufs, dessen Komponenten und die Verknüpfung zwischen den einzelnen Teilbereichen beschrieben und diskutiert, insbesondere das thermodynamische Hintergrundwissen, die hydrologischen Umwandlungsprozesse, einfache Statistik und Frequenzanalyse. In den Übungen vertiefen die Studierenden die einzelnen Teilaspekte und in Laborpraktikum und Geländearbeit wenden sie das erworbene Wissen an. Die hierbei erworbenen Kenntnisse und Qualifikationen sollen wesentliche Grundlagen für das weiterführende Modul Water Cycle 2 liefern.

Students will be given a comprehensive introduction to the multidisciplinary field of water cycle. The basic features of the global water cycle, its components and the linkage between the individual subdomains are described and discussed, in particular the thermodynamic background knowledge, the hydrological transformation processes, simple statistics and frequency analysis. In the exercises the students deepen the individual aspects and in laboratory practical course and field work they apply the acquired knowledge. The knowledge and qualifications acquired here should provide an essential basis for the advanced module Water Cycle 2.

Calculation of student workload:
146 h Self-study
40 h Exam preparation
84 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
PD Dr. Mahyar Mohtadi

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
9 / 270 hours

Module examinations

Module examination: Modulprüfung Water Cycle1

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Water Cycle 1

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
6,00

Teaching format(s):
Lecture
Tutorial
Field trip

Associated module examination:
Modulprüfung Water Cycle1

Module 01-PHY-BA-WatCy2: Water Cycle 2
Water Cycle 2

Assignment to areas of study:
- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:
none

Learning content:
This module teaches the fundamentals of the global water cycle through coordinated teaching content. The focus is on applied physical, statistical, and chemical background knowledge. First, there is an introduction to the sub-areas of the cryosphere, including ice sheets, ice caps, glaciers, sea ice, and icebergs. Remote sensing and measurement of sea ice is illustrated by a laboratory experiment. In addition, the structure of the water column and water masses in the oceans, ocean currents, and sea level fluctuations are explained. The biogeochemical cycle and its interaction with the water cycle are explored in depth in this course. Finally, the isotopy of water and its measurement and interpretation in various archives are presented, as are control and feedback mechanisms of the water cycle on different time scales.

Practical examples and exercises on the above topics are offered weekly and worked on together. At the end of the semester, students work in groups to present topics on sustainability that they have developed themselves in a seminar.

Learning outcomes / competencies / targeted competencies:
Students receive a comprehensive introduction to the multidisciplinary field of the water cycle. The basics of the global water cycle, its components, and the links between the sub-areas are described and discussed. The focus is on thermodynamic background knowledge, hydrological conversion processes, simple statistics, and frequency analysis. In the exercises, students deepen their understanding of the individual aspects; in the laboratory practical and seminar, they apply the knowledge they have acquired in a practical setting. The knowledge and qualifications acquired in this way form an essential basis for the advanced modules in the third semester.

Calculation of student workload:
146 h Self-study
40 h Exam preparation
84 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
PD Dr. Mahyar Mohtadi

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 26 / -

Credit points / Workload:
9 / 270 hours

Module examinations

Module examination: Modulprüfung Water Cycle 2

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Water Cycle 2

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
6,00

Literature:

- Bierkens, M., Dolman, H. and Troch, P. (2008). Climate and the Hydrological Cycle, pp 344, International Association of Hydrological Sciences, ISBN: 1901502546
- Shiklomanov, I. A. (2009). Hydrological Cycle - Volume I, pp 350, EOLSS Publications, ISBN: 1848260245

Teaching format(s):
Lecture
Tutorial
Seminar
Laboratory class

Associated module examination:
Modulprüfung Water Cycle 2

Module 01-PHY-BA-Eng1: Energy 1
Energy 1

Assignment to areas of study:

- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:

none

Learning content:

· Energy, force and momentum in physics

· Principle of energy and momentum conservation (quantitative examples for conversion of kinetic energy to potential energy and heat)

· Introduction to electricity

· Introduction to energy in chemistry

· Conversion of different energy forms: radiation, wind and water

· Conversion of heat (conventional power plants, geothermal energy)

· Solar cells (descriptive)

· Energy balance and sources (descriptive): biological cell, earth, energy conservation law

· Energy gradients and flow as driving force in biological systems; energy conversion (light to redox potential, chemical energy, concentration gradients, membrane potential)
descriptive (Photosynthesis, solar energy, nuclear energy, hydrogen)

· Structure of the earth (incl. as energy sources - Atmo-, Kryo-, Hydro-, Lithosphere and geothermal processes)

· Hydrodynamics; waves, tides and shallow water processes and wind dynamics (aerodynamics)

· Overview about conventional energy production (fossil and nuclear energy - overview, exploration) & Renewable energy (wind, water, solar)

· Introduction into geophysical mapping techniques (seismic and non-seismic techniques)

Topics for Practical Work:

· work with simple solar elements in laboratory and outside in the field

· work with simple wind power plants

· determine energy content of water

measure energies for condensation and freezing of water

Learning outcomes / competencies / targeted competencies:

· Students will gain knowledge on conversion of wind to electrical energy and properties of solar panels

· Students have a proper understanding of the meaning of water in the earth system

Students are empowered to discuss all aspects of developing a sustainable energy strategy.

Calculation of student workload:
84 h SWS / presence time / working hours
156 h Preparation / follow-up work
30 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Jens Falta

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 25 / -

Credit points / Workload:
9 / 270 hours

Module examinations

Module examination: Modulprüfung Energy 1

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Energy 1 - Lecture 1

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung Energy 1

Module 05-GW-BA-Eng2: Energy 2
Energy 2

Assignment to areas of study:
- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:
none

Learning content:

· energy conversion II (quantitative)

· Basic thermodynamics, heat machine

· Basics of quantum mechanics, semiconductors, band gap, electron-hole concept, solar cells

· Basics of nuclear physics, elementary particles, nuclear fission and nuclear fusion

· nuclear power plant and nuclear fusion concept, radioactivity and nuclear decay, life times, etc

· Risks and problems of conventional energy production (fossil, nuclear (exploration, exploitation)

· Renewable energy - potential, exploitation, direct utilization, combined wind + heat + power storage, economic aspects, risks)

· Environmental impacts and potential geohazards => Risk assessments

· photovoltaics, künstliche Kraftstoffe, Atomkraft, Fusion

Topics for Practical Work:

· Development of a conceptual project outline for the installation of a wind farm - what are the steps to be considered and how/where do I get the necessary data? what to consider etc. => from exploration to planning to operation and risk assessment (e.g. wind park, geothermal power plant)

Concept for building and installation of solar panels. How do they best work under sunny and cloudy conditions? Where should they be installed?

Learning outcomes / competencies / targeted competencies:

· Students will gain knowledge on conversion of wind to electrical energy and properties of solar panels

· Students have a proper understanding of the meaning of water in the earth system

Students are empowered to discuss all aspects of developing a sustainable energy strategy.

Calculation of student workload:
91 h SWS / presence time / working hours
119 h Self-study
60 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr. Julia Gottschall

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
9 / 270 hours

Module examinations

Module examination: Modulprüfung Energy 2

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Energy 2

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
6,00

Teaching format(s):
Lecture
Seminar
Laboratory class

Associated module examination:
Modulprüfung Energy 2

Module 02-BIO-BA-Eco1: Ecology 1
Ecology 1

Assignment to areas of study:
- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:
none

Learning content:
- Key ecosystems and biomes
- Pro- & eukaryotic cells
- Invasion, transition, adaptations
- Trait ecology, from genotype to phenotype
- Species concept
- Taxonomy
- Biodiversity research
- Individuals, populations, communities
- Ecological relationships of organisms
- Food webs
- Microbial ecology
- Data Science: Big Data, Meta Data, High-throughput data
- Bioinformatics: sequence analysis
- Statistics: univariate statistics (t-test, ANOVA, linear regression, correlation)

Learning outcomes / competencies / targeted competencies:
By the end of the course, students will be able to present how different biodiversity patterns occur by incorporating aspects of invasion, adaptation, and traits into their reasoning.

Students can present the different species concepts and explain how these should be considered in taxonomic classification. They can independently use macroscopic features or sequence characteristics to identify species.

In the context of biodiversity analyses, students will be able to select between different sequence analysis methods and statistical evaluations and assess the advantages and pitfalls of individual methods.

Calculation of student workload:
50 h Exam preparation
60 h Self-study
70 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr. Marlis Reich

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Ecology 1

Type of examination: combination exam

Form of examination:
Presentation and written assignment

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / 1 / -

Language(s) of instruction:
English

Description:
PL1: presentation and written assignment

SL1: assignment

Module courses

Course: Biodiversity, from its components to goods and services

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
5,00

Additional comments:
Lecture 2,5 SWS
Seminar 1,5 SWS
Excercises 1,5 SWS

Teaching format(s):
Lecture
Tutorial
Seminar

Associated module examination:

Module 05-GW-BA-Eco2: Ecology 2
Ecology 2

Assignment to areas of study:

- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:

none

Learning content:

General topic:

. Principles of ecology

Specific Topics:

. Structure and general properties of ecosystems

. Paleoecology

. Biogeography

. Ecosystem functions and services

. global change biology (physical stress, habitat models)

. Ecosystems response

. Conservation biology: vulnerability, conservation, invasive species, extinctions and habitat fragmentation, anthropogenic pressure.

. Biomonitoring

. Macroecology

. Multivariate statistics (PCA, MANOVA, PERMANOVA, NMDS, Multiple linear regression)

Learning outcomes / competencies / targeted competencies:

. Students have a basic understanding of the variety of species assemblages

. Students can link the variation of habitats and communities to the variation of abiotic and biotic environmental factors, including human impact.

. Students understand the importance of adaptations and traits for the structure and function of ecological communities

. Students have gained insight into different ecosystem services of communities, species conservation and environmental protection to safeguard a sustainable future

. Students understand the importance of mathematical models for quantifying habitats and species niches

. Students are able to quantitatively assess a variety of stressors to ecosystems by using multivariate analyses

Calculation of student workload:

70 h SWS / presence time / working hours
30 h Exam preparation
80 h Self-study

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr. Raphael Morard

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 25/26 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Ecology 2

Type of examination: combination exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
2 / - / -

Language(s) of instruction:
English

Description:
50% final exam

50% practical work (in exercise, seminar and excursion)

Module courses

Course: Ecology 2

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
5,00

Teaching format(s):
Lecture
Tutorial
Seminar
Field trip

Associated module examination:
Modulprüfung Ecology 2

Module 01-PHY-BA-ClimC1: Climate Change 1
Climate Change 1

Assignment to areas of study:

- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:

none

Learning content:

General topic:

The main basis for the understanding of climate change are observations which are collected at weather stations and environmental satellites. We approach to characterize the climate at particular aspects:

- Climate change - from local to global scales
- Climate components and exchange processes
- Observations: instrumental data; climate data from space

Specific Topics:

1) Temperature in time and space domain

Temperature seasonality: incoming and outgoing radiation, Earth orbit, heat capacity of different climate components

Temperature change: Natural and anthropogenic greenhouse gas effect, energy balance, energy transport, climate zones, polar amplification, ice-albedo feedback

2) Climate phenomena

Weather maps and circulation; evaluation of dominant forces, Coriolis effect, geostrophic flow, atmospheric jet stream

Climate phenomena: monsoon, ENSO, mid-latitude circulation

Climate extremes: storms, heat waves and droughts

3) Climate as a dynamical system

Time scales of the climate sub-systems (atmosphere, hydrosphere, biosphere, cryosphere)

Past climate changes and reconstructions using proxy data (isotopes)

Steady-states, exchange processes and multiple equilibria

Topics for Practical Work:

- Visualization and analysis of climate data using observations and satellite products
- Greenhouse effect, global vs. local differences in warming
- One-dimensional energy balance model: Analytical solution, applications with existing program, first steps towards programming
- Estimation of time scales of climate components, feedback strength
- Python/R/Jupyter for climate scientists

Learning outcomes / competencies / targeted competencies:
Students learn about the complex structure of the climate system in which many processes interact on different temporal and spatial scales. The climate is not constant, but subject to fluctuations from glacial/interglacial to short-term time scales. To understand the processes involved, the different driving mechanisms will be evaluated to study the effect of

- Changes of greenhouse gases and the Earth's energy balance
- Feedback mechanisms and climate (in)stability

Students understand the importance of time series analysis and have a basic understanding of mathematical models for quantifying climate change. Targeted competences are

- Visualization and analysis of climate data
- Stability of dynamical systems
- Basic programming skills and use of notebooks

Students will learn how to use meteorological instruments and observations (weather related instruments).

Students will get familiar with the content of recent climate assessment reports and are actively involved in recent scientific work.

Calculation of student workload:
84 h SWS / presence time / working hours
146 h Self-study
40 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
PD Dr. Martin Werner

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
9 / 270 hours

Module examinations

Module examination: Modulprüfung Climate Change 1

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Climate Change 1

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
6,00

Literature:
Archer, D., Global Warming: Understanding the Forecast, 2006, ISBN 978-1-4051-4039-3,

Goose, H., Climate system dynamics and modelling, Cambridge University Press, Cambridge, 2015, 358 pp.

Holton, J.R., and Hakim, G. J., 2013: Introduction to Dynamical Meteorology, Academic Press, Oxford (UK). —Fifth edition / Gregory J. Hakim. ISBN 978-0-12-384866-6

Lohmann, G., 2020: Climate Dynamics: Concepts, Scaling and Multiple Equilibria. Lecture Notes 2020, Bremen, Germany. (pdf of the script)

Pruscha, H., 2013: Statistical Analysis of Climate Series Analyzing, Plotting, Modeling, and Predicting with R, VIII, 176 p.

Python for climate scientists

https://github.com/duncanwp/python_for_climate_scientists

Ruddiman, W.F. Earth’s Climate Past and Future

Saltzman, B., Dynamical Paleoclimatology - A generalized theory of global climate change, Academic Press, San Diego, 2002, 354 pp.

Stocker, T. F., 2011. Introduction to Climate Modelling. Springer. SBN 978-3-642-00773-6

The Warming Papers: The Scientific Foundation for the Climate Change Forecast David Archer and Raymond Pierrehumbert (Eds.). Book about Global warming papers

Teaching format(s):
Lecture
Tutorial
Seminar
Project

Associated module examination:
Modulprüfung Climate Change 1

Module 01-PHY-BA-ClimC2: Climate Change 2
Climate Change 2

Assignment to areas of study:

- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:

none

Learning content:

General topic:

- Ongoing and future climate changes

Specific Topics:

- natural and forced climate variations
- Carbon cycle
- Fluid mechanics
- Cryosphere and sea level changes
- climate modeling primer
- scenarios and projections
- mitigation & adaptation concepts
- feedbacks in the climate-carbon cycle-ice system

Topics for Practical Work:

- Retrieval, visualization and analysis of output from Earth system models (global to regional scales)
- Design of climate model experiments and analysis
- Enhanced programming skills and use of notebooks
- Analysis of extreme events (heat waves, storms, floodings, droughts)

Evaluation of external forcing as Earth orbital parameters, volcanoes, sunspots, and their effect on temperature, sea ice etc.

Learning outcomes / competencies / targeted competencies:

The students shall learn that climate is determined by the interplay of all spheres of the Earth (land surfaces, oceans, atmosphere, cryosphere), external mechanisms, internal variability and human influences. The analysis of changing weather and climate pattern over time is a target of this course.

Specific aspects are

- sources and sinks of greenhouse gases
- climate variability patterns on all time scales
- separating shifts in mean, variance and extremes of climate and weather changes
- Understanding of ice sheet dynamics and sea level rise
- Create climate models (mostly in Python/R using Jupyther (through hands-on programming exercises.
- Learning and application of pattern analysis for climate science

assessment of mitigation/adaptation strategies

Calculation of student workload:
84 h SWS / presence time / working hours
40 h Exam preparation
146 h Self-study

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. rer. nat. Gerrit Lohmann

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
9 / 270 hours

Module examinations

Module examination: Modulprüfung Climate Change 2

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Climate Change 2

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
6,00

Literature:
Archer, D., Global Warming: Understanding the Forecast, 2006, ISBN 978-1-4051-4039-3,

Archer, D., The Global Carbon Cycle (Princeton Primers in Climate), Princeton University Press ISBN 978-0-691-14413-9

Gershenfeld, N., The nature of mathematical modeling, Cambridge University Press, Cambridge, 2003, 344 pp.

Goose, H., Climate system dynamics and modelling, Cambridge University Press, Cambridge, 2015, 358 pp.

Holton, J.R., and Hakim, G. J., 2013: Introduction to Dynamical Meteorology, Academic Press, Oxford (UK). —Fifth edition / Gregory J. Hakim. ISBN 978-0-12-384866-6

Lohmann, G., 2020: Climate Dynamics: Concepts, Scaling and Multiple Equilibria. Lecture Notes 2020, Bremen, Germany. (pdf of the script)

Marchal, J., Plumb, R. A., 2008. Atmosphere, Ocean and Climate Dynamics: An Introductory Text. Academic Press, 344 pp;

Ruddiman, W.F. Earth's Climate Past and Future

Stocker, T. F., 2011. Introduction to Climate Modelling. Springer. SBN 978-3-642-00773-6

The Warming Papers: The Scientific Foundation for the Climate Change Forecast David Archer and Raymond Pierrehumbert (Eds.). Book about Global warming papers

Teaching format(s):
Lecture
Tutorial
Seminar
Laboratory class

Associated module examination:
Modulprüfung Climate Change 2

Module 01-PHY-BA-NatRes1: Natural Resources 1
Natural Resources 1

Assignment to areas of study:
- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:
none

Learning content:
General topic:

• Dynamic Earth: volcanism, rock cycle, weathering and consequences for atmosphere and ocean composition

· Principles of electric fields and currents

· Principles of magnetism

· Principles of electromagnetism

• Principles of waves (electromagnetic)

• Principles of optics

• Earth materials: structure, composition, and physical properties of minerals

Specific Topics:

• Crystallography

• Rock-forming processes

• Metal deposits: nature and origin

Learning outcomes / competencies / targeted competencies:
· Students will be able to apply basic chemical principles to study geochemical reactions in nature and understand the principles of materials chemistry.

· Students will have acquired a basic understanding of geochemical cycles, mineral stability and properties, and the formation of mineral and metal deposits, and will be able to apply this knowledge to the evaluation of geologic resources.

· Students will have the basic knowledge of mathematical methods to describe electric fields, waves and interference.

· Students will have basic knowledge in the description of electric fields and currents as well as magnetism.

· Students understand the coupling between electrical and magnetic fields and the involved phenomena.

· Students will have acquired a basic understanding of wave optics, diffraction of light, electrons and X-rays, interference, optical instruments as well as investigation of crystal structures.

Calculation of student workload:
84 h SWS / presence time / working hours
60 h Exam preparation
126 h Self-study

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Martin Eickhoff

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
9 / 270 hours

Module examinations

Module examination: Modulprüfung Natural Resources 1

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Natural Resources 1

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
6,00

Teaching format(s):
Lecture
Tutorial
Laboratory class

Associated module examination:
Modulprüfung Natural Resources 1

Module 02-BIO-BA-NatRes2: Natural Resources 2
Natural Resources 2

Assignment to areas of study:
- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:
Modul Energy 1, Ecology 1

Learning content:
General Topic:

- Biological resources
- Principles of biomass production in natural and anthropogenic systems
- Biodiversity & Genetic resources

Specific Topics:

- Photosynthesis, carbon fixation, primary & secondary production, carbon & energy flow
- Land-based biological resources: soils (microbial cycles), agriculture & forestry
- Ocean-based biological resources fisheries & aquaculture (fish, invertebrates, seaweed, multitrophic)
- Mathematics: Stock assessment, sustainable yield
- Chemistry: Redox reactions in photosynthesis, chemistry of nitrogen and carbon, uptake kinetics
- Physics: Membrane transport, radiation transfer
- Geosciences: soil characteristics for agriculture and forestry

Learning outcomes / competencies / targeted competencies:
Students have a basic understanding of the variety and characteristics of renewable & biological resources.

Students understand the principles of biomass generation.

Students can link resources to their use, availability and application.

Students understand the potential hazards of resource uses.

Students can take part in topical discussion of resource uses, opportunities, risks and limitations both in the scientific and societal framework.

Calculation of student workload:
70 h Self-study
54 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Kai Bischof

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Natural Resources 2

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
PL1: written exam

Module courses

Course: Biological Resources

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Additional comments:
lecture 2 SWS
seminar 1 SWS
exercises 1 SWS

Teaching format(s):
Lecture
Tutorial
Seminar

Associated module examination:

Module 05-GW-BA-NatRes3: Natural Resources 3
Natural Resources 3

Assignment to areas of study:
- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:
none

Learning content:
General topic:

· Conflicts, challenges & new approaches

Specific Topics:

¿ Raw materials for renewable energy (Rare earths)

¿ Renewable energy sources in the society

· wind/generators, power grids, tidal power plants vs. environment

· accessibility/availability of resources

· exploitation of wild stocks vs. cultivation

· carbon capture (alkalinity enhancement, ”blue carbon“)

· Recycling

· Biofuels

Topics for Practical Work:

Interdisciplinary excursion. Examples are:

· Norwegian Fjords. Aquaculture (seaweed, salmon), energy (water & geothermal, mining),

· Aquaculture plants in Bremerhaven

· Green hydrogen production site

· Tidal power plants

Wind parks

Learning outcomes / competencies / targeted competencies:
Students have competence in discourse of conflicts in resource exploitation and conservation

Students are aware of social/ecologic/technological conflicts and solution strategies

Students gain experience in scientific presentations and discussion and arguing and develop strategies for complex decisions

Students become aware of opportunities, risks and limitations both in the scientific and societal framework

Calculation of student workload:
126 h Preparation / follow-up work
84 h SWS / presence time / working hours
60 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Wolfgang Bach

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
9 / 270 hours

Module examinations

Module examination: Modulprüfung Natural Resources 3

Type of examination: module exam

Form of examination:
Project report

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Natural Resources 3

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
6,00

Teaching format(s):
Lecture
Tutorial
Field trip

Associated module examination:
Modulprüfung Natural Resources 3

Module 02-BIO-BA-OneHe: One Health
One Health

Assignment to areas of study:

- Compulsory Modules / Foundations in Natural Sciences for Sustainability

Content-related prior knowledge or skills:

none

Learning content:

General Topic:

- General concepts of One Health (interplay of human, veterinary and ecological health to prevent new diseases and foster global health)
- Contributors to global Health and disease

Specific Topics:

Nutritional science

- Introduction to nutritional science malnutrition and obesity
- healthy diets for all
- cellular and organ metabolism
- nutrition based pathophysiology

Global Public Health (involve FB11/BIPS)

- Introduction to Epidemiology & demography
- International health and global burden of disease: infections, non-communicable diseases, mental health
- History and future of pandemics, natural disasters and humanitarian crises
- Infectious diseases as threats to global health in animals and humans: bacteria, viruses and parasites.
- Zoonotic infectious diseases, research across borders
- antibiotic and antiviral therapeutic strategies, historic and future vaccination strategies

Sustainable agriculture and resources

- Microbes and plant resources for sustainable agriculture and nutrition
- Ecology/Biodiversity
- Pollution and Health Risks

Topics for Practical Work:

- Food Security and Food Safety
- Cellular response to starvation and overnutrition

Required disciplinary knowledge:

- Mathematics: data analysis / statistics
- Biology: laboratory experience, basic concepts of ecology, metabolism, basic biochemistry

Disciplinary knowledge covered:

Biology/Biochemistry:

- concepts of infectious diseases
- virology
- concepts of nutrition
- agriculture
- food security & safety
- cellular and organ metabolism

Learning outcomes / competencies / targeted competencies:

- To understand basic concepts of One Health; the interconnectivity between human, veterinary and environmental health
- To integrate basic knowledge of cellular biology, biochemistry and physiology for sustainable health
- To learn and develop global sustainable agriculture for global nutrition
- To understand and apply basics of epidemiology
- To understand history and future of zoonotic diseases and pandemics and basic concepts for prevention and therapy

Calculation of student workload:
68 h Self-study
56 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr. Kathrin Mädler

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
SoSe 26 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung One Health

Type of examination: module exam

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
PL1: Oral Presentation

Module courses

Course: Molecular Medicine

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Lecture

Associated module examination:

• • • • • • • • •

Course: Special Aspects of Global Health

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Seminar

Associated module examination:
Modulprüfung One Health

Module 05-GW-BA-SelfPro: Self-Designed Project
Self-Designed Project

Assignment to areas of study:
- Compulsory Modules / Self-designed Project

Content-related prior knowledge or skills:
none

Learning content:
Together with the student, a sub-topic of the respective discipline is selected, which represents a contribution to current research work. After getting familiar with the literature, the students present a scientific question derived from the topic with a work plan, which is then intensively discussed and agreed upon. The main part is the processing. The work includes as many typical subject-related working techniques as possible. The focus is set according to the students' abilities and depending on the topic. The results are presented in a research report.

Learning outcomes / competencies / targeted competencies:
The students should be able to define a scientific question based on an outlined topic, to define a scientific question, derive hypotheses from it and develop a work plan to confirm or refute these hypotheses or disprove these hypotheses with suitable experiments. Furthermore, they should learn to write a research report in a structured, comprehensible and linguistically appropriate manner.

Calculation of student workload:
360 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Heiko Pälike

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
12 / 360 hours

Module examinations

Module examination: Modulprüfung Self-Designed Project

Type of examination: module exam

Form of examination:
Project report

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Self-Designed Project

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
1,00

Literature:
Related to the research topic.

Teaching format(s):
Seminar

Associated module examination:
Modulprüfung Self-Designed Project

Module 01-PHY-BA-InEO: Introduction to Earth Observation
Introduction to Earth Observation

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Physics

Content-related prior knowledge or skills:
none

Learning content:
General topic:

· satellite orbits and instruments

· theoretical background of remote sensing methods and radiative transfer

· retrieval and data analysis methods

· principles of active and passive satellite remote sensing

· spectroscopic techniques

· applications to atmospheric composition, aerosols, surface

Topics for Practical Work:

- Computational: analysis of satellite datasets using google earth engine, python and online tools
- Field/lab: acquire and analysis of spectra for different materials and substances

Learning outcomes / competencies / targeted competencies:

· Students will have acquired an understanding of the fundamental remote sensing methods and some key applications.

· Students will understand the key benefits and limitations of satellite observations

· Students will have gained insights into the handling and visualization of EO data

· Students will have familiarized themselves with remote sensing instruments using practical examples

Calculation of student workload:
84 h SWS / presence time / working hours
40 h Exam preparation
56 h Self-study

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Hartmut Bösch

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Introduction to Earth Observation

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Introduction to Earth Observation

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
6,00

Literature:
· Burrows, P. Borrell, U. Platt, The remote sensing of tropospheric composition from space, , Springer, ISBN: 978-3-642-14791-3

· G. Petty, A first course in atmospheric radiation, Sundog Pub, ISBN-10: 0972903313

Teaching format(s):
Lecture
Seminar

Associated module examination:
Modulprüfung Introduction to Earth Observation

Module 01-PHY-BA-InDat: Introduction to Data Analysis and Data Visualization
Introduction to Data Analysis and Data Visualization

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Physics

Content-related prior knowledge or skills:
none

Learning content:
General topic:

- Learn and understand the basics of computer programming and establish good programming habits

Specific Topics:

- Introduction to programming languages, high level programming languages and differences between interpreted and compile languages
- Flow charts and their use in coding
- Install all needed software for python programming (Jupyter notebooks/git version control)
- Introduction to version control
- Familiarization with the Jupyter interface
- Introduction to python

sic data structures and data types

- tabular data math in python
- the numpy library
- the scipy library
- conditionals
- loops
- read data from files and save data to files
- basic math operations
- date handling and timeseries
- visualization of data in python
- the matplotlib library

Learning outcomes / competencies / targeted competencies:

· basic knowledge of data handling using high level languages (python)

· basic knowledge of data presentation using computer programming (generating figures)

Calculation of student workload:
68 h Exam preparation
56 h SWS / presence time / working hours
56 h Self-study

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr. Nikolaos Daskalakis

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Introduction to Data Analysis and Data Visualization

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Introduction to Data Analysis and Data Visualization

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung Introduction to Data Analysis and Data Visualization

Module 01-PHY-BA-AdDat: Advanced Data Analysis and Visualization
Advanced Data Analysis and Visualization

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Physics

Content-related prior knowledge or skills:
none

Learning content:
General topic:

• data analysis using advanced libraries and object oriented programming, scaling to larger computing systems

Specific Topics:

- basics of object oriented programming
- methods in python
- data analysis and manipulation using pandas
- use of labelled multi-dimensional arrays
- using common data form for reading/saving data
- image analysis
- parallelization using jit

from notebooks to programs

- running python programs using the command line
- the PEP8 syntax guidelines

Learning outcomes / competencies / targeted competencies:
· Advanced knowledge of data handling using high level languages (python)

· Advanced knowledge of data presentation using computer programming (generating figures)

Calculation of student workload:
56 h Self-study
68 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr. Nikolaos Daskalakis

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Advanced Data Analysis and Visualization

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Advanced Data Analysis and Visualization

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung Advanced Data Analysis and Visualization

Module 01-PHY-BA-AtChBGC: Atmospheric Chemistry and Biogeochemistry Cycles

Atmospheric Chemistry and Biogeochemistry Cycles

Assignment to areas of study:

- Compulsory Elective Modules / Focus Area Physics

Content-related prior knowledge or skills:

none

Learning content:

General topic:

- introduction to atmospheric chemistry and biogeochemical cycles

Specific Topics:

- anthropogenic influence

· Global biochemical cycles of elements

· important biophysical processes in atmosphere and ocean

· carbon-, methane-, nitrogen and water cycle, greenhouse gases

· exchange of subsystems of earth

· use of remote sensing

Learning outcomes / competencies / targeted competencies:

· Advanced knowledge of atmospheric processes

· Advanced knowledge of exchange processes in biogeochemistry

Calculation of student workload:

68 h Self-study
56 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr. Annette Ladstätter-Weißenmayer

Frequency:

winter semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

WiSe 24/25 / -

Credit points / Workload:

6 / 180 hours

Module examinations

Module examination: Modulprüfung Atmospheric Chemistry and Biogeochemistry Cycles

Type of examination: module exam

Form of examination:
Oral examination (single)

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Atmospheric Chemistry and Biogeochemistry Cycles

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Literature:
Will be announced in the first lecture.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung Atmospheric Chemistry and Biogeochemistry Cycles

Module 01-ET-BA-RERI: Renewable Energy Resources and Infrastructures
Renewable Energy Resources and Infrastructures

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Physics

Content-related prior knowledge or skills:
none

Learning content:
- Measurement of solar irradiation and wind
- Solar Energy Systems
- Wind Energy Systems
- Thermal Solar Systems: low temperature applications
- Thermal Solar Systems: power plants
- Geothermal Energy Systems
- Hydropower and Ocean Energy Systems
- Introduction into electrical (power systems) and heat infrastructures
- Aspects of plant design and calculation of economic efficiency
- Aspects of massive integration of renewables in infrastructures

Learning outcomes / competencies / targeted competencies:
· After successful completion of the course, students will be familiar with the various energy conversion processes and technologies of regenerative energy production as well as their potentials and limitations.

· The students will learn tools for the technically and economically optimized design of smaller plants.

· The Students will have basic knowledge about the problems/solutions of integration of renewable energy resources in supply infrastructure in order to follow general discussions.

Calculation of student workload:
60 h Preparation / follow-up work
70 h SWS / presence time / working hours
50 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr.-Ing. Johanna Myrzik

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Renewable Energy Resources and Infrastructures

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Renewable Energy Resources and Infrastructures

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
5,00

Literature:
Volker Quaschning: Understanding Renewable Energy Systems, 2016.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung Renewable Energy Resources and Infrastructures

Module 02-BIO-BA-EcoBio: Current Research in Ecology and Biodiversity
Current Research in Ecology and Biodiversity

Assignment to areas of study:

- Compulsory Elective Modules / Focus Area Biology

Content-related prior knowledge or skills:

none

Learning content:

Lecture: BIODIVERSITY

- basic definitions of the concept of biodiversity
- origin and temporal changes of biodiversity
- spatial and ecological patterns of biodiversity and their causes
- biodiversity and ecosystem functions
- biodiversity in change: emergence and disappearance of biological entities
- methods of biodiversity research
- biodiversity and society

ECOLOGICAL SEMINAR & LITERATURE CLUB

- lectures by invited researchers from the national and international research environment
- analysis, critical discussion and synoptic review of recent publications on selected research fields

Learning outcomes / competencies / targeted competencies:

BIODIVERSITY

The students

- have a basic understanding of the main concepts of biodiversity based on current scientific literature
- are able to identify different biodiversity patterns
- understand the high importance of the archiving and documentation of biodiversity information
- are able to reflect on the significance of biodiversity for ecosystem functioning and service provisioning in a societal context, with special reference to sustainable development.

ECOLOGY SEMINAR/ LITERATURE CLUB

The students

- understand the content of scientific ecological articles;
- know different scientific methods and research approaches in ecology and understand their differences, advantages and disadvantages
- can critically examine ecological data
- take a stand in the discussion of ecological problems
- apply their English skills in relation to ecological content
- can summarize and present current research projects concisely and accurately

Calculation of student workload:

56 h SWS / presence time / working hours
30 h Exam preparation
94 h Self-study

Are there optional courses in the modules?

no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Martin Diekmann

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Kombinationsprüfung Current Research in Ecology and Biodiversity

Type of examination: combination exam

Form of examination:
Presentation, oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
2 / - / -

Language(s) of instruction:
English / German

Description:
PL1: oral presentation (Literature Club)

PL2: oral presentation (Basics in Biodiversity)

Module courses

Course: Basics in Biodiversity

Frequency:
winter semester, yearly

Language(s) of instruction:
English / German

Contact hours:
2,00

Additional comments:
Lecture 1 SWS
Seminar 1 SWS

Teaching format(s):
Lecture
Seminar

Associated module examination:

• • • • • • • • •

Course: Ecological Seminar

Frequency:
winter semester, yearly

Language(s) of instruction:
English / German

Contact hours:
1,00

Teaching format(s):
Lecture

Associated module examination:

• • • • • • • • •

Course: Literature Club

Frequency:
winter semester, yearly

Language(s) of instruction:
English / German

Contact hours:
1,00

Teaching format(s):
Seminar

Associated module examination:

Module 02-BIO-BA-MetBio: Methods in Molecular Biosciences
Methods in Molecular Biosciences

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Biology

Content-related prior knowledge or skills:
none

Learning content:
Lecture: (Methods for the quantification of biomolecules)

- separation of biomolecules
- protein purification
- methods of immunology
- genetic engineering and biotechnology
- cell biology
- microscopy

Seminars:

Topics for Practical Work:

- Gene cloning and analysis of cloning success
- Cultivation and transformation of bacteria
- Determination of enzyme activities
- Cultivation of eukaryotic cells
- Transfection of eukaryotic cells with expression plasmids
- Manipulation of cellular processes by viral infections
- Analysis of cellular transport processes
- Analysis of cellular defense mechanisms against viral pathogens (PAMP-recognition)

Learning outcomes / competencies / targeted competencies:
- Students will gain knowledge in theory and practice on methods in Molecular Biosciences.
- Students learn to apply methods of genetic engineering and quantitative microbiology.
- Students learn to establish methods for the quantification of biomolecules.
- Students have a proper understanding of biotechnical approaches.
- Students are empowered to discuss and develop aspects of a sustainable biotechnology.

Calculation of student workload:
30 h Exam preparation
84 h SWS / presence time / working hours
66 h Self-study

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Uwe Nehls

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Kombinationsprüfung Methods in Molecular Biosciences

Type of examination: combination exam

Form of examination:
Oral

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / 1 / -

Language(s) of instruction:
English / German

Description:
PL1: Oral Examination
SL1: protocols

Module courses

Course: Methods in Molecular Biosciences

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Lecture

Associated module examination:

• • • • • • • • •

Course: Microbiology

Frequency:
winter semester, yearly

Language(s) of instruction:
English / German

Contact hours:
4,00

Additional comments:
Seminar 1 SWS
Practical Laboratory Course 1,5 SWS

Teaching format(s):
Seminar
Laboratory class

Associated module examination:

Module 02-BIO-BA-MarEco: Marine Ecology
Marine Ecology

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Biology

Content-related prior knowledge or skills:
none

Learning content:
General Topic:

Functionality of Marine Ecosystems

Specific Topics:

- Introduction into different Marine Habitats (Pelagic, Benthic, Coastal, Deep Sea, Polar, Tropics)
- Principles of Marine Ecosystem Function
- Exemplified at UNESCO World Heritage Site & National Park Niedersächsisches Wattenmeer
- Introduction into latest research topics and findings

Topics for Practical Work:

Interdisciplinary excursion to: UNESCO World Heritage Site & National Park Niedersächsisches Wattenmeer

Learning outcomes / competencies / targeted competencies:
Students have an overview on the principles of ecosystem function in different marine habitats

Students are aware of ecological and sociological conflicts in and climate pressures on different marine ecosystems

Students become aware of latest ongoing research in marine ecology

Calculation of student workload:
56 h SWS / presence time / working hours
94 h Self-study
30 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Kai Bischof

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Marine Ecology

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
PL1: written exam (based on lecture Introductory Marine Biology)

Module courses

Course: Introductory Marine Biology

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
Nybakken & Bertness (2009) Marine Biology – An ecological approach; 6. Ed. Pearson/Benjamin Cummings

Teaching format(s):
Lecture

Associated module examination:

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Course: Ocean Sciences Colloquium

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
1,00

Teaching format(s):
Lecture

Associated module examination:

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Course: Ecology of the Wadden Sea

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
1,00

Teaching format(s):
Field trip

Associated module examination:

Module 05-GW-BA-BMG-PO3: From Past to Future Ocean Conditions
From Past to Future Ocean Conditions

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Geosciences

Content-related prior knowledge or skills:
none

Learning content:
This module will cover current topics related to role of the ocean for climate change as well as the use of the sea by humans and their consequences. An intense discussion on themes of the future ocean and on Global Change consequences related to e.g. modern ocean acidification and warming will be triggered from actual scientific knowledge (e.g. IPCC, SRU, etc.).

Learning outcomes / competencies / targeted competencies:
To get familiar with current topcis on climate change and its consequences
To be able to critically evaluate reports on climate change
To communicate the consequences of climate change
To work objective-oriented and problem-based individually as well as in a team

Calculation of student workload:
84 h Self-study
40 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Dr. Torsten Bickert

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 23/24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: From Past to Future Ocean Conditions

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
100 % Presentation with written elaboration

Module courses

Course: Future ocean

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
Will be provided

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung BMG-PO3 From Past to Future Ocean Conditions

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Course: Global Change

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
Suitable sources should be found by the students themselves

Teaching format(s):
Seminar

Associated module examination:

Module 05-GW-BA-BMG-GI1: Research Data Management and Analysis
Research Data Management and Analysis

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Geosciences

Content-related prior knowledge or skills:
Computer Course: Python

Learning content:
Fundamentals of research data management, bringing order into data collection, documentation, storage and use, including basic concepts of metadata description.
Finding and accessing research data from multidisciplinary data sources.
Use of scientific data portals, metadata-supported search. Introduction into domain specific scientific data formats, standards and terminologies (e.g. ontologies).
Reuse of research data with Python: loading data into data frames, getting an overview on the data, data cleaning, exploration and preparation.
Basic and advanced statistics with Python using PANGAEA data. Distribution analysis, missing data treatment, outlier detection. Applied data analytics, regression analysis, trends, smoothing. Basic plotting of data using Python.

Learning outcomes / competencies / targeted competencies:
Students are acquainted to the data life-cycle and the FAIR data principles.
Students are introduced to methods to manage, submit and archive research data in relevant information systems.
Students will learn how to understand and select appropriate ontologies and community standards.
Students are introduced to methods for data handling, data exploration, data analysis and statistics with Python.

Calculation of student workload:

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Frank Oliver Glöckner

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 23/24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Research Data Management and Analysis

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
100 % written exam

Module courses

Course: Research Data Management

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
Will be provided in the lecture

Teaching format(s):
Lecture

Associated module examination:
Modulprüfung BMG-GI1 Research Data Management and Analysis

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Course: Applied Data Management and Analysis

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
3,00

Literature:
Will be provided in the course

Teaching format(s):
Tutorial

Associated module examination:
Modulprüfung BMG-GI1 Research Data Management and Analysis

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Course: Research Data Management Seminar

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
0,00

Literature:
Will be provided in the seminar

Teaching format(s):
Seminar

Associated module examination:
Modulprüfung BMG-GI1 Research Data Management and Analysis

Module 05-GW-BA-BMG-GI3: Earth-System Modeling and Data Analysis
Earth-System Modeling and Data Analysis

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Geosciences

Content-related prior knowledge or skills:
Fundamentals of mathematics, physics and chemistry

Learning content:
Numerical models are widely used across all fields in Earth Sciences. This course introduces the basic concept of finite difference techniques for solving differential equations. The focus is on reservoir models that are applied, for example, in geochemistry, paleoceanography, or climatology. Computer labs using Python form the core of the course. In the second part, the students learn about the analysis of climate data stemming from 4-dimensional observations or climate models, i.e., gridded data in time and space.

Learning outcomes / competencies / targeted competencies:
understanding key concepts and assumptions underlying numerical models
basic understanding of discretization in space and time using finite differences
ability to transfer modeling concept to simple geoscientific problems
ability to analyse 4-dimensional climate data

Calculation of student workload:
56 h Self-study
68 h Exam preparation
56 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Michael Schulz

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 23/24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Earth-System Modeling and Data Analysis

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
100 % written exam

Module courses

Course: Earth-System Modeling Primer

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
Kendal McGuffie, Ann Henderson-Sellers: The Climate Modelling Primer, 4th Edition. Wiley-Blackwell, 456 pp.,2014.
Hartmann, Dennis L.: Global Physical Climatology. Elsevier, 2nd edition, 498 pp., 2016.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung BMG-GI3 Earth-System Modeling and Data Analysis

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Course: Earth-System Data Analysis

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
Kendal McGuffie, Ann Henderson-Sellers: The Climate Modelling Primer, 4th Edition. Wiley-Blackwell, 456 pp.,2014.
Hartmann, Dennis L.: Global Physical Climatology. Elsevier, 2nd edition, 498 pp., 2016.

Teaching format(s):
Laboratory class

Associated module examination:
Modulprüfung BMG-GI3 Earth-System Modeling and Data Analysis

Module 05-GW-BA-BMG-EE3: Physical, Chemical and Biological Oceanography
Physical, Chemical and Biological Oceanography

Assignment to areas of study:
- Compulsory Elective Modules / Focus Area Geosciences

Content-related prior knowledge or skills:
Fundamentals of Physics and Chemistry

Learning content:
This module introduces the basic processes in the atmosphere and ocean, investigates their essential forcing factors and explains the interaction between the two systems. Selected physical aspects are the Earth´s energy and water balances, the general circulation of the atmosphere, the wind-driven and thermohaline circulation of the ocean, the water masses and their formation as well as coastal upweling. Furthermore, it provides an overview of the biological productivity and carbon export in the ocean and their relation to macronutrients, trace elements and the ocean circulation. Exercises are an intergral part of this module and allow for a deeper insight in the important physical-chemical-biological processes in the atmosphere and ocean.

Learning outcomes / competencies / targeted competencies:
to identify key factors influencing the Earth´s climate system
to describe the processes that cause large-scale ocean currents
to recognize that ocean currents, marine life and the turnover of energy and matter are closely interlinked
to explain the elementary marine biogeochemical processes and outline the ""biological pump"" and its role in the marine carbon cycle

Calculation of student workload:
70 h SWS / presence time / working hours
68 h Exam preparation
42 h Self-study

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Heiko Pälike

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 23/24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Physical, Chemical and Biological Oceanography

Type of examination: module exam

Form of examination:
Announcement at the beginning of the semester

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
100% written exam

Module courses

Course: Climate and Ocean

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
5,00

Literature:
Charles Cockell et al.: An Introduction to the Earth-Life System. Cambridge University Press, 326 pp.,2008.
Hartmann, Dennis L.: Global Physical Climatology. Elsevier, 2nd edition, 498 pp., 2016.
Open University: Ocean Circulation. Butterworth-Heinemann, 2nd revised edition, 286 pp., 2004.
Open University Course Team (1997). Biological Oceanography: An Introduction. Butterworth-Heinemann, 2.Auflage, 314 p.
Open University Course Team (2005) Marine Biogeochemical Cycles. Butterworth-Heinemann, 2.Auflage, 130 p.
Open University Course Team (1995). Seawater: its composition, properties and behaviour. Butterworth-Heinemann, 2.Auflage, 168 p.
Libes, S.M. (2009). An Introduction to Marine Biogeochemistry. Academic Press, 2.Auflage, 928 p.
Levinton, J.S. (2013). Marine Biology: Function, Biodiversity, Ecology. Oxford University Press, 4.Auflage, 576 p.

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Modulprüfung BMG-EE3 Physical, Chemical and Biological Oceanography

Module 09-PHI-BA-EnvEt: Environmental and Climate Ethics
Environmental and Climate Ethics

Assignment to areas of study:
- General Studies Area / Compulsory Modules

Content-related prior knowledge or skills:
none

Learning content:
General topic:

· Clarification and definition of central concepts lile sustainability, climate justice, equality, future generations

· Deliberation on central aspects of our understanding and interpretation of the concept of nature

· Introduction into basic issues within ecological ethics and climate ethics

· Discussion of sustainability-concepts, individual and collective responsibility concerning the climate crisis, responsibiliy for future generations, principles of climate justice

Learning outcomes / competencies / targeted competencies:
- Students understand the importance of environmental climate ethics as integral part of research
- Students develop an understanding for the importance of transdisciplinary research / work
- Students recognize potential for career development in environmental climate ethics

Calculation of student workload:
106 h SWS / presence time / working hours
56 h Preparation / follow-up work
18 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Dagmar Borchers

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Environmental and Climate Ethics

Type of examination: module exam

Form of examination:
Oral examination (single)

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Environmental and Climate Ethics

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Literature:
Will be provided in the lecture

Teaching format(s):
Seminar

Associated module examination:
Modulprüfung Environmental and Climate Ethics

Module 01-PHY-BA-FSW: Fundamentals of Scientific Work
Fundamentals of Scientific Work

Assignment to areas of study:
- General Studies Area / Compulsory Modules

Content-related prior knowledge or skills:
none

Learning content:
Rules for writing scientific experimental reports and articles (structure, writing style, presentation of formulae, inclusion of graphics, microtypographical aspects, bibliography). Structure of scientific oral presentations, layout, formulae, copyright, correct citation, rules for good scientific practice.

Introduction to programming languages using Python as an example.
Types of measurement uncertainties, statistics, calculation of the measurement uncertainty of indirect measurands. Introduction to scientific evaluation programmes (e.g. QTI-Plot, Excel), data analysis and presentation with Python in the context of JupyterHub used as an example for an Electronic Laboratory Notebook.
These maths-based topics correspond to a workload of 2 CPs.

Learning outcomes / competencies / targeted competencies:
Participants in this module should gain basic skills in the use of Python for data analysis and learn how to create scientific presentations and publications.

Calculation of student workload:
56 h SWS / presence time / working hours
62 h Exam preparation
62 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Kathrin Sebald

Frequency:
winter semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
6 / 180 hours

This module is ungraded!

Module examinations

Module examination: Kombinationsprüfung Fundamentals of Scientific Work (Exercises)

Type of examination: combination exam

Form of examination:
See description

The examination is ungraded?
yes

Number of graded components / ungraded components / prerequisites of the examination:
- / 3 / -

Language(s) of instruction:
English

Description:
70% of all achievable points of the set tasks (exercise tasks on data analysis), 1 presentation and 1 written article on a topic of their own choice in the field of sustainability research with a focus on physics.) in the semester.

Module courses

Course: Fundamentals of Scientific Work

Frequency:
winter semester, yearly

Language(s) of instruction:
English

Contact hours:
4,00

Teaching format(s):
Lecture
Tutorial

Associated module examination:
Kombinationsprüfung Fundamentals of Scientific Work (Exercises)

Module 01-PHY-BA-KnTran: Knowledge Transfer in Modern Science
Knowledge Transfer in Modern Science

Assignment to areas of study:
- General Studies Area / Elective Modules

Content-related prior knowledge or skills:
none

Learning content:
General topic:

Knowledge transfer is an essential part in modern science, today. It offers practical advice and knowledge-based data and provides customised information to authorities and municipalities, associations and companies. Just as it also addresses the general public and other target groups and is fundamental for societal decision-making processes. Knowledge transfer uses a variety of formats to address different target groups in a tailor-made manner.

Specific topics:

- Principles of knowledge transfer / science communication
- Knowledge transfer vs technology transfer
- Climate change and society, impacts and measures
- IPCC and international political background
- National framework of climate protection and adaptation
- Methods of knowledge transfer and best practices
- Principles of project management
- Bridging disciplines, a fundament of climate protection and sustainability

KT concrete: developing a KT project in groups

Topics for practical work:

- Excursion Klimahaus Bremerhaven, Aquaculture
- Excursion ELISE
- Meeting a climate protection agency

Learning outcomes / competencies / targeted competencies:
- Students understand the importance of knowledge transfer in modern sciences as integral part of research
- Students develop an understanding for the importance of transdisciplinary research / work
- Students recognize potential for career development in climate protection outside science
- Students understand the process of structured project management

Calculation of student workload:
50 h Exam preparation
42 h SWS / presence time / working hours
88 h Preparation / follow-up work

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
N.N.

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 23/24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Modulprüfung Knowledge Transfer in Modern Science

Type of examination: module exam

Form of examination:
Presentation and written assignment

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
Developing a knowledge transfer project / project work, presentation and written summary; Seminar contribution

Module courses

Course: Knowledge Transfer in Modern Science

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
3,00

Literature:
Beuthner, M., Bomnüter, U. and Kantara, J.(editors) (2022): Risiken, Krisen, Konflikte, Springer VS, Wiesbaden, Springer, 18 p., ISBN: 978-3-658-36194-5, doi: 10.1007/978-3-658-36195-2_14.

Grosfeld, K., Treffeisen, R., Asseng, J. and Heygster, G. (2018): The web portal 'meereisportal.de' in context of ESKP, In: G. Krause (ed.), Building bridges at the science-stakeholder interface - Towards knowledge exchange in Earth System Science, SpringerBriefs in Earth System Sciences, Cham, Switzerland, Springer, ISBN: 978-3-319-75918-0.

G. Krause (ed.) (2018): Building bridges at the science-stakeholder interface - Towards knowledge exchange in Earth System Science, SpringerBriefs in Earth System Sciences, Cham, Switzerland, Springer, ISBN: 978-3-319-75918-0 .

Marx, A. (ed.) (2017): Klimaanpassung in Forschung und Politik, Wiesbaden, Springer Spektrum, 260 p., ISBN: 978-3-658-05577-6 . doi: 10.1007/978-3-658-05578-3

Marx, A. , Treffeisen, R. , Grosfeld, K. , Hiller, W. , Heygster, G. , Samaniego, L. , Kumar, R. , Pommerencke, J. and Zink, M. (2017): Wissenschaftliche Informationen für die Anwendung / A. Marx (editor) , Klimaanpassung in Forschung und Politik, Wiesbaden, Springer Spektrum, 260 p., ISBN: 978-3-658-05577-6 . doi: 10.1007/978-3-658-05578-3.

Meinke, I.: On the comparability of knowledge transfer activities – a case study at the German Baltic Sea Coast focusing regional climate services, Adv. Sci. Res., 14, 145–151, https://doi.org/10.5194/asr-14-145-2017, 2017.

Meinke, I.: Stakeholder-based evaluation categories for regional climate services – a case study at the German Baltic Sea coast, Adv. Sci. Res., 14, 279–291, https://doi.org/10.5194/asr-14-279-2017, 2017.

Treffeisen, R. and Grosfeld, K. (2022): Herausforderung Klimawandel – Kommunikation und Wissenstransfer zwischen Fakten und gesellschaftlicher Handlungsnotwendigkeit / M. Beuthner , U. Bomnüter and J. Kantara (editors) , In: Risiken, Krisen, Konflikte, Springer VS, Wiesbaden, Springer, 18 p., ISBN: 978-3-658-36194-5 . doi: 10.1007/978-3-658-36195-2_14. Treffeisen, R., Grosfeld, K., and Kuhlmann, F. (2017): Deriving evaluation indicators for knowledge transfer and dialogue processes in the context of climate research, Adv. Sci. Res., 14, 313–322, https://doi.org/10.5194/asr-14-313-2017.

Trümper, S. and Beck, M.-L.(2021): Transformative Klimakommunikation: Veränderungsprozesse in Wissenschaft und Gesellschaft anstoßen, GAIA - Ecological Perspectives for Science and Society, 30,3, doi:10.14512/gaia.30.3.7, https://www.ingentaconnect.com/content/oekom/gaia/2021/00000030/00000003/art00008.

Teaching format(s):
Lecture

Associated module examination:
Modulprüfung Knowledge Transfer in Modern Science

Module 07-WW-BA-PubFinFis: Public Finance and Fiscal Sustainability in Multilevel Systems

Public Finance and Fiscal Sustainability in Multilevel Systems

Assignment to areas of study:

- General Studies Area / Elective Modules

Content-related prior knowledge or skills:

none

Learning content:

General topic:

The content of the course follows the lecture's outline:

Chapter 1: An Introduction to Public Finance and Provision of Public Goods

Chapter 2: Basics of Fiscal Federalism Theory

Chapter 3: Concept of Fiscal sustainability

Chapter 4: Basic Elements of Municipal Equalization Schemes

Chapter 5: Municipal Equalization System in Germany

Chapter 6: Municipal Equalization System in Ukraine

Chapter 7: Economic Problems, Alternative Solutions, and Reform

Learning outcomes / competencies / targeted competencies:

The seminar "Public Finance and Fiscal Sustainability in Multilevel Systems" gives bachelor's degree students an overview of the theoretical and institutional foundations of the ***economic activities*** *of* ***local*** *and* ***regional governments*** *within a* ***multilevel system****.*

The course deals with normative and positive theoretical approaches to identify and describe efficient ***assignments of competences*** *as well as efficient* ***equalization systems*** *in multilevel systems. Thus, the course also focusses on* ***legal frameworks*** *and institutions for local and regional decision-makers and* ***fiscal sustainable developments*** *of local and regional public budgets.*

After having studied the seminar, with comprehensive economic state-of-the-art analytical instruments the students will be able to identify economic reasons for local public finance and local self-governance in multilevel systems and to assess the impact of specific current local economic and fiscal policy instruments within a social market economy. Students understand the frameworks and conditions for fiscal sustainability of sub-level units in multilevel systems.

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After having studied the seminar, with comprehensive economic state-of-the-art analytical instruments the students will be able to identify economic reasons for local public finance and local self-governance in multilevel systems and to assess the impact of specific current local economic and fiscal policy instruments within a social market economy. Students understand the frameworks and conditions for fiscal sustainability of sub-level units in multilevel systems.

§ *Teaching the ability to understand the economic justification of local and regional public activities and its problems to achieve fiscal sustainability.*

§ *Teaching comprehensive economic state-of-the-art analysis.*

§ *Get a comprehensive overview of current relevant economic theory of local and regional public activities within a social market economy.*

§ *Teaching the abilities to use and to improve aquired skills to unterstand current complexe problems in the context of local and regional public expenditure*

§ *Get a comprehensive overview of the specific situation of city states in the German federal system and specific entities in Ukraine.*

Competences:

§ *Students will be able to identify and analyze local and regional public finance and its benefits in theoretical terms.*

§ *Students can identify current economic problems on the level of municipalities and the level of regions in different countries.*

§ *Students can analyze the circumstances, conditions and frameworks for fiscal sustainability of local and regional public budgets.*

§ *Students can discuss reform options or economic alternatives.*

§ *Students can prepare and present a scientific work.*

Calculation of student workload:
124 h Preparation / follow-up work
28 h Exam preparation
28 h SWS / presence time / working hours

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. André Heinemann

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 23/24 / -

Credit points / Workload:
6 / 180 hours

Module examinations

Module examination: Public Finance and Fiscal Sustainability in Multilevel Systems

Type of examination: module exam

Form of examination:
Written examination

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Module courses

Course: Public Finance and Fiscal Sustainability in Multilevel Systems

Frequency:
summer semester, yearly

Language(s) of instruction:
German

Contact hours:
2,00

Teaching format(s):
Lecture

Associated module examination:
Public Finance and Fiscal Sustainability in Multilevel Systems

Module 08-GEO-BA-PBSus: Planetary Boundaries and Sustainable Development Goals

Planetary Boundaries and Sustainable Development Goals

Assignment to areas of study:

- General Studies Area / Elective Modules

Content-related prior knowledge or skills:

none

Learning content:

General topic:

1. Planetary Boundaries Framework
2. Sustainable Development Goals

Specific Topics:

- From “Limits to growth” to “Planetary boundaries”
- The Anthropocene debate
- Regime shifts and Tipping points
- Major developments in global environmental policy since the Rio (1992) summit
- The UN’s Sustainable Development Goals approach, including SDG Targets and Indicator Frameworks
- Social-ecological transformation and just transition

Learning outcomes / competencies / targeted competencies:

Students understand the main lines of global environmental thinking in terms of (global) limits and boundaries.
Students can argue the different positions with regard to the role of economic growth in global environmental change.
Students can contextualize the planetary boundaries concept in the larger anthropocene debate.
Students are knowledgeable about the main developments in global environmental policy since the Rio (1992) summit.
Students are informed about the SDG framework and can work with the target and indicator framework.
Students can situate the SDG framework in broader debates about social-ecological transformation and environmental justice.

Calculation of student workload:

28 h SWS / presence time / working hours
90 h Exam preparation
62 h Preparation / follow-up work

Are there optional courses in the modules?

no

Language(s) of instruction:

English

Responsible for the module:

Prof. Dr. Michael Flitner

Frequency:

summer semester, yearly

Duration:

1 semester[s]

The module is valid since / The module is valid until:

WiSe 24/25 / SoSe 26

Credit points / Workload:

6 / 180 hours

Module examinations

Module examination: Modulprüfung Planetary Boundaries and Sustainable Development Goals

Type of examination: module exam

Form of examination:
Presentation and written assignment

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
1 / - / -

Language(s) of instruction:
English

Description:
Project work, presentation and written summary; Seminar contribution

Module courses

Course: Planetary Boundaries and Sustainable Development Goals

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Seminar

Associated module examination:
Modulprüfung Planetary Boundaries and Sustainable Development Goals

Module 01-PHY-BA-ThsSus: Bachelor Thesis including Colloquium
Bachelor Thesis including Colloquium

Assignment to areas of study:
- Bachelor Thesis

Content-related prior knowledge or skills:
Successful completion of the compulsory and elective modules

Learning content:
Based on the chosen focus, a bachelor's thesis is prepared. The topic of the bachelor's thesis and the resulting results are discussed in the accompanying seminar

Learning outcomes / competencies / targeted competencies:
- Realization of a scientific question into an experimental and/or theoretical investigation
- Application of successful strategies in planning and conducting scientific investigations
- Discussion of a scientific question into an experimental and/or theoretical investigation
- Ability to critically evaluate, classify and discuss one's own scientific results
- Ability to critically evaluate, classify and discuss one's own scientific results
- Ability to summarise and present scientific results in a bachelor thesis

Calculation of student workload:
422 h Self-study
28 h SWS / presence time / working hours
90 h Exam preparation

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
Prof. Dr. Annette Ladstätter-Weißenmayer

Frequency:
summer semester, yearly

Duration:
1 semester[s]

The module is valid since / The module is valid until:
WiSe 24/25 / -

Credit points / Workload:
15 / 450 hours

Module examinations

Module examination: Colloquium

Type of examination: module exam

Form of examination:
Colloquium

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
German

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Module examination: Bachelor Thesis

Type of examination: partial exam

Form of examination:
Bachelor Thesis

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
2 / - / -

Language(s) of instruction:
English

Description:
Bachelor Thesis incl. Colloquium

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Module examination: Bachelor Seminar

Type of examination: partial exam

Form of examination:
See description

The examination is ungraded?
yes

Number of graded components / ungraded components / prerequisites of the examination:
- / 1 / -

Language(s) of instruction:
English

Module courses

Course: Bachelor Thesis incl. Colloquium

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
-

Literature:
Related to the research topic.

Teaching format(s):
Self-study unit

Associated module examination:
Bachelor Thesis
Colloquium

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Course: Seminar

Frequency:
summer semester, yearly

Language(s) of instruction:
English

Contact hours:
2,00

Teaching format(s):
Accompanying seminar (for Bachelor and Master Thesis)

Associated module examination:
Bachelor Seminar

Module 01-PHY-BA-0 NatSus: Additional Courses for Bachelor "Natural Sciences for Sustainability"

Additional Courses for Bachelor "Natural Sciences for Sustainability"

Assignment to areas of study:

- Additional Courses

Content-related prior knowledge or skills:
none

Learning content:

Learning outcomes / competencies / targeted competencies:
In this “module”, which is not part of the examination regulations, we inform you about courses that would otherwise no longer be visible in StudIP due to the new display structure. These may be seminars, information events or general studies courses.

If you consider taking an examination in one of the courses, please ask your lecturer about the correct registration modalities.

Calculation of student workload:

Are there optional courses in the modules?
no

Language(s) of instruction:
English

Responsible for the module:
N.N.

Frequency:

Duration:

The module is valid since / The module is valid until:
SoSe 25 / -

Credit points / Workload:
0 / 0 hours

Module examinations

Module examination: ohne Prüfung

Type of examination: module exam

Form of examination:
See description

The examination is ungraded?
no

Number of graded components / ungraded components / prerequisites of the examination:
- / - / -

Language(s) of instruction:
English

Module courses

Course: Additional Courses for Bachelor "Natural Sciences for Sustainability"

Frequency:

Language(s) of instruction:
English

Contact hours:
0,00

Teaching format(s):

Associated module examination: