Description of the degree program

Environmental Sciences (Bachelor)
PO 3

Date: 19.01.2026

Table of contents

Basics of Natural Sciences

Title	Mathematical Methods		
Number	1497040	**Module version**	
Shorttext		**Language**	
Frequency of offer		**Teaching unit**	Fakultät Architektur, Bauingenieurwesen und Umweltwissenschaften Fakultät für Lebenswissenschaften
Module duration		**Institution**	
Hours per Week / ECTS	0 / 12,0	**Module owner**	Prof. Dr. Sigurd Bauerecker
Workload (h)	360 h		
Class attendance (h)		**Self studying (h)**	
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			

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Related courses
Rules for the choice of courses
Compulsory attendance

Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Exercise	german
	3,0	Lecture	german

	2,0	Exercise	german
	3,0	Lecture	german

Title	General and Inorganic Chemistry		
Number	1601260 Bt-BP 01	**Module version**	
Shorttext	BT-BBT2-26	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	Fakultät für Lebenswissenschaften
Module duration	1 Semester	**Institution**	
Hours per Week / ECTS	7 / 7,0	**Module owner**	Prof. Dr. Marc Walter
Workload (h)	210		
Class attendance (h)	98	**Self studying (h)**	112
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			
- Riedel, E.; Meyer, H.-J., Allgemeine und Anorganische Chemie, 12. Auflage, de Gruyter Berlin 2019 - Mortimer, C.E.; Müller, U., Chemie – Das Basiswissen der Chemie, 11. Auflage, Georg Thieme Verlag, 2014.			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	4,0	Lecture	german
	3,0	Internship	german

Title	Organic Chemistry for Environmental Sciences		
Number	1499970	**Module version**	
Shorttext		**Language**	
Frequency of offer		**Teaching unit**	Fakultät für Lebenswissenschaften
Module duration		**Institution**	
Hours per Week / ECTS	3 / 4,0	**Module owner**	Prof. Dr. Thomas Lindel
Workload (h)	120 h		
Class attendance (h)		**Self studying (h)**	
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			
- Hart, Organische Chemie, 3. Auflage 2007, VHC - Vollhardt, Organische Chemie, 4. Auflage 2007, VHC - Riedel, Allgemeine und Anorganische Chemie, 9. Auflage 2008, de Gruyter			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
Organic Chemistry	4,0	Lecture	german
		Exercise	german

Title	Physics I for Environmental Sciences and Engineers		
Number	1521050	**Module version**	
Shorttext		**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	Fakultät Architektur, Bauingenieurwesen und Umweltwissenschaften Fakultät für Elektrotechnik, Informationstechnik, Physik
Module duration		**Institution**	
Hours per Week / ECTS	3 / 4,0	**Module owner**	
Workload (h)	120		
Class attendance (h)	72	**Self studying (h)**	48
Compulsory requirements			
Expected performance/ Type of examination	Written exam (90min)		
Course achievement			

Contents

Knowledge of physical quantities and units, kinematics and dynamics, including energy, momentum, circular motion, liquids and gases, including pressure and properties of flowing liquids. Thermodynamics, including heat transport, states of matter, gas law and the laws of thermodynamics.

Objective qualification

Students learn the physical principles of mechanics and thermodynamics, which are required to understand the processes in the Earth's interior and to develop methods for recording and dealing with environmentally relevant issues.
This includes: Physical quantities and units, kinematics and dynamics, including energy, momentum, circular motion, fluids and gases, including pressure and properties of flowing fluids. Thermodynamics, including heat transport, states of matter, gas law and the laws of thermodynamics.

Literature

Will be announced in the course.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**

		Lecture/Exercise	german

		Lecture/Exercise	german

Physics I for Environmental Scientists and Environmental Engineers	2,0	Lecture	german
Literature			
Ulrich Haas, Physik für Pharmazeuten und Mediziner, 6. Auflage, ISBN 3-8047-1823-X Trautwein, Kreibig, Hüttermann, Physik für Mediziner, Biologen, Pharmazeuten, 7. Auflage, ISBN 978-3-11-019792-1			

Physics I for Environmental Scientists and Environmental Engineers	1,0	Exercise	german
Literature			
Ulrich Haas, Physik für Pharmazeuten und Mediziner, 6. Auflage, ISBN 3-8047-1823-X Trautwein, Kreibig, Hüttermann, Physik für Mediziner, Biologen, Pharmazeuten, 7. Auflage, ISBN 978-3-11-019792-1			

Title	Physics II for Environmental Sciences and Engineers		
Number	1521070	**Module version**	
Shorttext	PHY-IGeP-29	**Language**	
Frequency of offer		**Teaching unit**	Fakultät Architektur, Bauingenieurwesen und Umweltwissenschaften Fakultät für Elektrotechnik, Informationstechnik, Physik
Module duration		**Institution**	
Hours per Week / ECTS	/ 4,0	**Module owner**	
Workload (h)	120 h		
Class attendance (h)	42 h	**Self studying (h)**	78 h
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			
Wird in der Veranstaltung bekanntgegeben.			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**

	2,0	Lecture	german
Literature			
Ulrich Haas, Physik für Pharmazeuten und Mediziner, 6. Auflage, ISBN 3-8047-1823-X Trautwein, Kreibig, Hüttermann, Physik für Mediziner, Biologen, Pharmazeuten, 7. Auflage, ISBN 978-3-11-019792-1			

	1,0	Exercise	german
Literature			
- Ulrich Haas, Physik für Pharmazeuten und Mediziner, 6. Auflage, ISBN 3-8047-1823-X - Trautwein, Kreibig, Hüttermann, Physik für Mediziner, Biologen, Pharmazeuten, 7. Auflage, ISBN 978-3-11-019792-1.			

Basics Environmental Systems

Title	Atmosphere		
Number	1514160	**Module version**	
Shorttext	PHY-IGÖ-16	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	2	**Institution**	Abteilung für Klimatologie und Umweltmeteorologie
Hours per Week / ECTS	5 / 7,0	**Module owner**	Prof. Dr. Stephan Weber
Workload (h)	210		
Class attendance (h)	74	**Self studying (h)**	136
Compulsory requirements			
Expected performance/ Type of examination	Written exam (120 Min.)		
Course achievement			

Contents

[Climatology(V+Ü)]
- General Climatology and Climate Geography

[Ecological and Terrain Climatology (V)]
- Basics of boundary layer processes (energy and matter fluxes)
- Terrain climatic processes
- Atmosphere-biosphere interaction
- Application and learning of professionally relevant methods (use of climatological measurement techniques, data analysis and presentation)

[Ecological and Terrain Climatology (P)]
- Field exercise for the lecture Ecological Climatology (4th semester), 3 field days
- Application and learning of job-relevant methods (use of climatological measurement techniques, data analysis and presentation).

Objective qualification

After successful completion of the module Atmosphere, students have basic knowledge in the areas of general climatology, climate geography, and atmospheric boundary layer processes. They are able to comprehend the essential interrelationships of atmospheric processes in the climate system and to derive interactions with the land surface. They also have practical and job-relevant knowledge in the application of climatological measurement techniques to answer questions about terrain and ecological climate.

Literature

Wird in der VL bekanntgegeben

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture	german
	1,0	Exercise	german
	1,0	Lecture	german
	1,0	Internship	german

Title	Biosphere		
Number	1116160	**Module version**	
Shorttext	GEA-UA-16	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	2	**Institution**	Institut für Geosysteme und Bioindikation
Hours per Week / ECTS	6 / 8,0	**Module owner**	Prof. Dr. Antje Schwalb
Workload (h)	240		
Class attendance (h)	98	**Self studying (h)**	142
Compulsory requirements			
Expected performance/ Type of examination	Written exam (90 Min.)		
Course achievement			

Contents

- [Biodiversity and Evolution (V)]
- Introduction to systematics, concept of species, family tree and evolution of organisms
- Types of microorganisms
- Cell structure, energy and metabolism of microorganisms
- Evolution, phylogenetics and taxonomy of microorganisms
- Diversity of bacteria
- Diversity of archaea and fungi
- Diversity of algae
- Diversity of mosses and ferns
- Diversity of seed plants
- Diversity of animals: invertebrates
- Diversity of animals: vertebrates

- [Biological Identification Exercises (Ü)]
- Laboratory exercises with outdoor recording of plankton identification: algae and small crustaceans
- Laboratory exercises identification of flowering plants
- Field exercises identification of trees and forest types
- Field exercises biotypes using the mapping instructions of Lower Saxony
- Field exercises determination of selected groups of animals: dragonflies, amphibians, birds

Objective qualification

After successful completion of the module, students have basic knowledge about the diversity of life in all forms. They can assign the organisms to the different kingdoms and know their most important morphological and physiological characteristics. They have basic knowledge of the evolution of life.
After successful participation in the biological identification exercises, the students have practical experience in handling different types of identification keys. They are able to determine selected taxonomic groups.

Literature

Biodiversität:
- Campbell: Biologie. Spektrum, Heidelberg (jeweils neuester Jahrgang).

Bestimmungsübungen:
- Lehmann & Nüß: Libellen. Deutscher Jugendbund für Naturbeobachtung, Hamburg.
- Meisch, C., 2000. Freshwater Ostracoda of Western and Central Europe, Spektrum Akademischer Verlag, Hei-delberg, Berlin; 522 S.
- Rothmaler: Exkursionsflora von Deutschland, Bd. 2, 19. Auflage Svenson et al.: Der neue Kosmos Vogel-führer: alle
Arten Europas, Nordafrikas und Vorderasiens. Kosmos, Stuttgart.

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Related courses

Rules for the choice of courses

Compulsory attendance

Name of the course	SWS	Eventtype	Language
	4,0	Exercise	german
	2,0	Lecture	german

Title	Geosphere 1 - Geology and Geomorphology		
Number	1199880	**Module version**	
Shorttext	GEA-IUG-07	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	1	**Institution**	Institut für Geosysteme und Bioindikation
Hours per Week / ECTS	6 / 8,0	**Module owner**	Prof. Dr. Antje Schwalb
Workload (h)	240		
Class attendance (h)	92	**Self studying (h)**	148
Compulsory requirements			
Expected performance/ Type of examination	Written exam (120 Min.)		
Course achievement	Protocol for field exercise geology and geomorphology		

Contents

[Geology (V)]
- History of geology, formation and structure of the Earth
- Processes at plate boundaries
- Earthquakes on the continents and in the ocean and plate tectonics
- volcanism
- Rock cycle
- Sediments and weathering
- Water, wind and ice as forces of erosion and transport media, mass movements
- Processes in the ocean, genesis of landscapes
- Raw materials
- Geological time, catastrophes and orogeny
- Carboniferous, Permian, Triassic: coal and salt
- Jurassic, Cretaceous, Tertiary, Quaternary: From greenhouse to ice house

[Geomorphology (V)]
- The way into the Ice Age
- Glacial processes, sediments and landforms
- Periglacial, fluvial and aeolian processes, sediments and landforms
- Landforms and sediments in Lower Saxony
- Landscape development during the Quaternary in Lower Saxony
- Landscape development during the Quaternary in Germany
- Formation of the German coast during the Holocene

Objective qualification

The Geosphere I module explains the essential geological and geomorphological processes that determine the external appearance of the Earth's surface. The contents of the lectures are practically deepened during field exercises. Endogenic and exogenic processes as well as land use that shape the landscape are addressed and identified. The students learn to identify and distinguish natural processes from anthropogenic impacts.

Literature

- John Grotzinger, Thomas Jordan: Press Siever Allgemeine Geologie, 2017
- Heinrich Bahlburg, Christoph Breitkreuz: Grundlagen der Geologie, 2017
- Martin Meschede, Geologie Deutschlands, 2015
- Harald Zepp, Geomorphologie
- Margot Böse, Jürgen Ehlers, Frank Lehmkuhl, Deutschlands Norden: vom Erdaltertum zur Gegenwart, 2018
- Joachim Eberle, Bernhard Eitel, Wolf Dieter Blümel, Peter Wittmann, Deutschlands Süden vom Erdmittelalter zur Gegenwart

↑

Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	3,0	Practical exercise	german
	2,0	Lecture	german
	1,0	Lecture	german

Title	Geosphere 2 - Mineralogy/Petrography and Geo-/Hydrochemistry		
Number	1111110	**Module version**	
Shorttext	GEA-IUG-11	**Language**	german
Frequency of offer	only in the summer term	**Teaching unit**	
Module duration	1	**Institution**	Abteilung Geochemie
Hours per Week / ECTS	6 / 8,0	**Module owner**	Prof. Dr. Harald Biester
Workload (h)	240		
Class attendance (h)	84	**Self studying (h)**	156
Compulsory requirements			
Expected performance/ Type of examination	Written exam (120 Min.)		
Course achievement			

Contents

[Basic Principles of Geochemistry and Hydrochemistry (VÜ)]
Formation and distribution of elements, chemical structure of the earth, water constituents-charge balance, alkalinity, KAK, Debye-Hückel-Theory, Activity, Activity Coefficients

[Mineralogy and Petrography (VÜ)]
Theoretical and practical exercises are offered. Superordinate topics: Exogenous and endogenous processes, structure and geological development of the earth, basic geology, palaeontology and mineralogy, history of the earth, practical activity in the field.

Objective qualification

Understanding of the relationships of thermodynamic principles of the inorganic hydrochemistry and geochemistry of natural systems such as water bodies and soils. Ability to distinguish natural from anthropogenic processes. Basic knowledge of biogeochemical driven fluxes of mattere in the environment. Application of basic geochemical knowledge to anthropogenic induced environmental problems Ability to calculate chemical reaction equilibria. Basic knowledge of the behaviour of some important pollutants and geochemical archives in the environment.

Literature

Minerale und Gesteine: - Georg Markl - Lehrbuch der Mineralogie Rössler - Mineralogie Matthes Geo- und Hydrochemie - Principles and Applications of Geochemistry. Gunter Faure. Prentice Hall, Inc., 1998. - Environmental Chemistry. Baird C, und Cann, M. Palgrave Macmillan, 2004 - Environmental Chemistry. van-Loon, G.W. und Duffy, S.J. Oxford University Press 2005. - Aquatische Chemie. Sigg, L. und Stumm, W.. Vdf Hochschulverlag AG, 1996. - Geochemistry, Groundwater and Pollution Appelo, C.A.J und Postma, D. 2 Edition (2005), A.A. Balkema. - Principles and Applications of Geochemistry. Gunter Faure. Prentice Hall, Inc., 1998.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture/Exercise	german
	4,0	Lecture/Exercise	german

Title	Hydrosphere		
Number	1514050	**Module version**	
Shorttext	PHY-IGÖ-05	**Language**	german
Frequency of offer	only in the summer term	**Teaching unit**	
Module duration	1	**Institution**	Abteilung Hydrologie und Flussgebietsmanagement
Hours per Week / ECTS	7 / 8,0	**Module owner**	Prof. Dr. Kai Schröter
Workload (h)	240		
Class attendance (h)	98	**Self studying (h)**	142
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	3,0	Lecture	german
	4,0	Lecture/Exercise	german

Title	Ecosphere		
Number	1116170	**Module version**	
Shorttext	GEA-UA-17	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	1	**Institution**	Abteilung für Landschaftsökologie und Umweltsystemanalyse
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Frank Suhling
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination	Written exam (90 Min.)		
Course achievement			

Contents

Ecology for Environmental Scientists: Characteristics of organisms - Organisms and their environment - Population ecology - Dispersal, migration and introduction of alien species - Evolutionary mechanisms - Interactions: Competition, predation, mutualism and parasitism - Ecosystem function and dynamics terrestrial, limnetic, marine and urban ecosystems - Global ecosystem change.
Landscape Ecology: Conceptual, methodological and theoretical foundations of landscape ecology, abiotic and biotic components of the landscape, quantitative approaches to the analysis of relationships between patterns and processes in landscapes

Objective qualification

After successful completion of the module Ecosphere, students have basic knowledge in the fields of organismal ecology and landscape ecology. They are able to understand the essential relationships of ecological processes that influence the occurrence of organisms and the composition of biological communities, such as interactions between abiotic and biotic eco-factors and the importance of disturbances. They have a basic understanding of population ecology and mechanisms of scientific conservation. In addition, they can recognize and describe biotic and abiotic patterns in the landscape and analyze and interpret the relationships between patterns and processes in landscapes.

Literature

[Ökologie]
Nentwig, W., Bacher, S., & Brandl, R. (2011). Ökologie kompakt. Heidelberg: Spektrum Akademischer Verlag. Begon, M., Howarth, R. W., & Townsend, C. R. (2016). Ökologie. Springer-Verlag.
Beides als E-Book vorhanden

[Landschaftsökologie]
Turner, M. G., R. H. Gardner & R. V. O'Neill (2001) Landscape ecology in theory and practice - pattern and process. New York, Springer

↑

Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture	german
	2,0	Lecture	german

Title	Pedosphere 1		
Number	1514030	**Module version**	
Shorttext	PHY-IGÖ-03	**Language**	german
Frequency of offer	only in the summer term	**Teaching unit**	
Module duration	1	**Institution**	Abteilung für Bodenwissenschaften
Hours per Week / ECTS	4 / 5,0	**Module owner**	Dr. Axel Don
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	94
Compulsory requirements			
Expected performance/ Type of examination	Written exam (90 Min.)		
Course achievement			

Contents

[Soil Science - Introduction (V)]
The lecture serves to convey a "soil science framework". The students acquire knowledge about the formation, ecological properties and essential functions of soils. After an introduction, basic knowledge about the relationship between parent rock and soil formation, about inorganic and organic soil matter, about soil as a habitat, about soil structure, about soil water balance, about factors and processes of soil development, about soil as ion exchanger and nutrient store, about soil systematics and distribution as well as about soil evaluation and soil protection will be imparted. Contents:

1. Introduction: soils as natural bodies, soil fertility, history of soil science
2. Soil forming rocks
3. Inorganic soil substance
4. Organic soil substance
5. Soil as habitat
6. Soil structure
7. Soil as water reservoir
8. Factors and processes of soil development
9. Soil as ion exchanger
10. Soil as nutrient reservoir
11. Soil systematics and distribution
12. Soil evaluation and soil protection

[Soil Profile Description (Exk).
Procedure and techniques of the pedological profile description. Familiarization with important natural units and soil types in the Braunschweig area.

Objective qualification

After successful participation in the module courses, the students know and understand
– the basic technical terms and methods of soil science
– the relationship between soil-forming factors and processes of soil formation, which lead to the expression of soil types.
– the systematics, distribution, ecological properties and essential functions of the most important soil types in Central Europe.

They are able to
– address and document soil profiles in the field in a scientifically correct manner using the tools commonly used for this purpose
– apply their knowledge with regard to soil evaluation as well as to practical problems of soil and water protection
– apply their knowledge.

Literature

Skript:
Nieder, R., 2014, Bodenkunde I, Grundlagen der Bodenkunde, 3. Semester Geoökologie, Skript zur Vorlesung
"Bodenkunde - Einführung".

Weitere Literatur:
Ad-hoc-Arbeitsgruppe Boden, 2005, Bodenkundliche Kartieranleitung, 5. Auflage, Thomas Münzer, Langensalza.

Ahl, C., Becker, K.W., Jörgensen, R.G. und Meyer, B., 2003, Aspekte und Grundlagen der der Bodenkunde. 30. Auflage, Göttingen und Witzenhausen, Eigenverlag.

Scheffer, F. und Schachtschabel, P., 2002, Lehrbuch der Bodenkunde, 15. Auflage, Spektrum, Heidelberg.

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Related courses

Rules for the choice of courses

Compulsory attendance

Name of the course	SWS	Eventtype	Language
	2,0	Exercise	german
	2,0	Lecture	german

Literature

Skript: Nieder, R., 2008, Bodenkunde I, Grundlagen der Bodenkunde, 3. Semester Geoökologie, Skript zur Vorlesung "Bodenkunde - Einführung". Weitere Literatur: Ad-hoc-Arbeitsgruppe Boden, 2005, Bodenkundliche Kartieranleitung, 5. Auflage, Thomas Münzer, Langensalza. Ahl, C., Becker, K.W., Jörgensen, R.G. und Meyer, B., 2003, Aspekte und Grundlagen der der Bodenkunde. 30. Auflage, Göttingen und Witzenhausen, Eigenverlag. Scheffer, F. und Schachtschabel, P., 2002, Lehrbuch der Bodenkunde, 15. Auflage, Spektrum, Heidelberg.

Title	Pedosphere 2		
Number	1514170	**Module version**	
Shorttext	PHY-IGÖ-17	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	1	**Institution**	Abteilung für Bodenwissenschaften
Hours per Week / ECTS	6 / 8,0	**Module owner**	Dr. Sascha Iden
Workload (h)	240		
Class attendance (h)	56	**Self studying (h)**	184
Compulsory requirements			
Expected performance/ Type of examination	Written exam (90 Min.)		
Course achievement			

Contents

[Water and material balance of soils (VÜ)]
- Processes and characteristics of the water, gas and material fluxes in soils,
- Functions of soil as a filter and reactor,
- Soil ecology.
- Biogeochemical cycles
- Importance of microorganisms for ecosystem services of soils.

[Soil Science Laboratory Practicum (L).
Experimental determination of soil physical, soil hydrological and soil chemical parameters on laboratory samples.

Objective qualification

After successful participation of the module courses the students know and understand
- the basic terminology and methods of soil physics
- the importance of soils for terrestrial biogeochemical cycles
- the main physicochemical and biological processes occurring in soils
- the principles and characteristics of the water, gas and material balance of soils
- basic soil physical and soil chemical analysis methods

They are able to
- analyze soil samples in the laboratory using standard soil physical and soil chemical methods
- evaluate and present measurements scientifically, and to interpret and evaluate the test results.

Literature

Durner W. and H. Flühler (2003): Transport and Accessibility of Solutes in Soils. Lecture Notes. TU Braunschweig.

Durner, W., and D. Or (2005): Chapter 73: Soil Water Potential Measurement, in: Anderson M.G. and J. J. McDonnell, Encyclopedia of Hydrological Sciences, Chapter 73, 1089-1102, John Wiley & Sons, Ltd.

Durner, W., and H. Flühler (2005): Chapter 74: Soil Hydraulic Properties, in: Anderson M.G. and J. J. McDonnell,Encyclopedia of Hydrological Sciences, Chapter 74, 1103-1120, John Wiley & Sons, Ltd.

Durner, W., and K. Lipsius (2005): Chapter 75: Determining Soil Hydraulic Properties, in: Anderson M.G. and J. J. McDonnell, Encyclopedia of Hydrological Sciences, Chapter 75, 1121-1144, John Wiley & Sons, Ltd.

Gisi, U. (Hrsg.): Bodenökologie, 2. Aufl., Georg Thieme Verlag, 1997, 351 Seiten, ISBN 3137472024, 9783137472025. Jury W.A., and R.E. Horton (1994): Soil Physics, 6th Edition. John Wiley & Sons, Hoboken, New Jersey.
Tindall J.A. and J.R. Kunkel (1999): Unsaturated Zone Hydrology. Prentice Hall, London.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	3,0	Exercise	german
	3,0	Lecture/Exercise	german
Literature			
Lehrbücher zur LV: - Jury und Horton (2006): Soil Physics, 6th ed. John Wiley & Sons, Inc. - Hartge/Horn (2014): Einführung in die Bodenphysik. 4. Auflage, Schweizerbart, Stuttgart. - Tindall J.A. und J.R. Kunkel (1999): Unsaturated Zone Hydrology for Scientists and Engineers. Prentice Hall, New Jersey.			

Area of Specialisation

Title	Agroecology		
Number	1116040	**Module version**	
Shorttext	GEA-UA-04	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	1	**Institution**	Institut für Geoökologie
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Jens Dauber
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination	Written exam (90 Min.)		
Course achievement			

Contents

[Introduction to Agroecology (V)]
1. ecological concepts in agroecology
2. agroecosystems
3. the origins of agriculture and the development of cultural landscapes
4. agriculture in the present and biodiversity
5. plant protection and agrobiodiversity
6. biotic interactions in agroecosystems, honey bees, biological pest control
7. organic farming, grassland
8. concepts of sustainable agriculture

[Agroecological Models (Ü)]
1. integrated farm system model (IFSM)
2. circuitscape
3. bee steward
4. simulation models

Objective qualification

Ability to analyse agricultural production systems in terms of environmental impacts, recognising local and global aspects. Understanding of agriculture as an actor and as an affected party of global change,
Ability to develop environmentally sound management concepts based on case studies.

Literature

Martin, Sauerborn (2006): Agrarökologie, UTB
Townsend, Begon, Harper (2008): Ökologie, Springer
Gliessman (2007): Agroecologie, CRC Press
diverse Paper, werden vorgelegt

↑

Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture	german
	2,0	Exercise	german

Title	Analytical Methods of Inorganic Geochemistry		
Number	1111040	**Module version**	
Shorttext	GEA-IUG-04	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	1	**Institution**	Abteilung Geochemie
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Harald Biester
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination	Portfolio		
Course achievement			

Contents

[Analytical-Geochemical Practical Course (L)]
Sampling of sediment or soil samples as well as different natural waters (lake, river, groundwater) Analysis: ICP-OES, ICP-MS, CVAAS: different elements (solid and liquid samples) Ion chromatography: main anions IR spectroscopy: C and S; TOC,TIC, DOC,TN, DON XRF multi-element analysis
Heavy metal speciation: CVAAS-Hg thermodesorption, heavy metals in soil eluates Data evaluation and plausibility

[Analytical Geochemistry Practical Course (V)]
Theory and practice of inorganic geochemistry, guidance for analytical-chemical work from sampling via instrumental inorganic analysis to result report, quality-assured determination of elemental contents in aqueous and solid environmental samples

Analytical methods in inorganic environmental geochemistry
Theory of instrumental analysis, quality control, calibrations, standards, references Statistical methods in analysis, limit of detection and limit of determination.

Objective qualification

Since the analysis of geochemically oriented geoecological problems is mostly based on the evaluation of measured data, the ability to evaluate geochemical data against the background of the applied analytical methods and the specific sampling strategy is the central qualification goal of this course. After an introducing lecture, the students are able to work out suitable sampling strategies for a geochemical problem and to select suitable analytical methods. Furthermore, they have the knowledge to assess the quality of measurement data, oriented towards valid standards and limit values. Based on the knowledge acquired in the practical part, they are also able to independently carry out the sampling of various environmental matrices and apply different analytical methods, evaluate their data and classify them with regard to correctness and relevance.

Literature

- Schwedt, G., Taschenatlas der Analytik, Wiley-VCH, Weinheim, 1996
- Camman, K., Instrumentelle Analytische Chemie. Verfahren, Anwendungen und Qualitätssicherung Spektrum
Akademischer Verlag GmbH, Heidelberg, 2001 Veranstaltungsskript
- Schatten, A. 1999. Statistik für Chemiker

- Instrumentelle Analytik, Skoog und Leary

↑

Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	4,0	Lecture/Exercise	german

Title	Aquatic Ecosystem Analysis I: Long-Term Monitoring		
Number	1199970	**Module version**	
Shorttext	GEA-STD-97	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	1	**Institution**	Institut für Geosysteme und Bioindikation
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Antje Schwalb
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination	Term paper Compulsory attendance in the lecture.		
Course achievement			

Contents

[Fundamentals of Limnology (V)]
-Introduction, history of limnology, water types and their origin and development, artificial waters
-Freshwater habitats, communities in water bodies
-Matter budget, food chain and succession
-Bioindication in aquatic systems (water quality analysis)
-Effects of climate change on aquatic systems
-Applied limnology (trophic, saprobic, eutrophication, microplastics, water acidification, mining, sanitation, restoration, ultrasound, sewage treatment plants)
-Paleolimnology
-Case studies for the investigation of limnic systems from current research

[Methods of sediment analysis (Ü)]
-Sediment as a component and archive of aquatic ecosystems
-Basic methods of sediment analysis
-Analysis of bioindicators for paleoenvironmental reconstruction
-Methods for sediment preparation, preparation preparation and microscopic analysis

Objective qualification

Building on the knowledge that the students have acquired during their previous studies, especially in the Biosphere and Geosphere I modules, they develop basic knowledge about the genesis, structure and properties of aquatic ecosystems as well as an understanding of limnological processes. After having completed the module, the students are able to characterize aquatic communities and their relationship to each other, to describe the balance of water bodies, to recognize the causes of eutrophication of water bodies and to assess its impact on the ecosystem. Furthermore, they can describe sediments as archives of aquatic ecosystems, analyze sediments in a fundamental way and thus derive the longer-term development of a water body

Literature

- Schönborn, W. & Risse-Buhl, U. (2013) . Lehrbuch der Limnologie. Schweizerbart Stuttgart. 669 S.
- Schwörbel, J. & Brendelberger, H. (2005). Einführung in die Limnologie. Elsevier, München. 340 S.

- Smol, J. P. (2008). Pollution of Lakes and Rivers. A Paleoenvironmental Perspective - 2nd Edition. Blackwell Publishing,
Oxford. 383 pp.
- Uhlmann, D. & Horn, W. (2001). Hydrobiologie der Binnengewässer: Ein Grundriss für Ingenieure und Naturwissenschaftler. UTB, Stuttgart, 528 S.
- Wetzel, R. (2001): Limnology - Lake and River Ecosystems. Academic Press, San Diego. 1066 pp.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture	german
	2,0	Exercise	german

Title	Aquatic Ecosystem Analysis II: Water Quality Assessment		
Number	1199980	**Module version**	
Shorttext	GEA-STD-98	**Language**	german
Frequency of offer	only in the summer term	**Teaching unit**	
Module duration	2	**Institution**	Abteilung für Landschaftsökologie und Umweltsystemanalyse
Hours per Week / ECTS	5 / 6,0	**Module owner**	Prof. Dr. Frank Suhling
Workload (h)	180		
Class attendance (h)	70	**Self studying (h)**	110
Compulsory requirements			
Expected performance/ Type of examination	Term paper		
Course achievement			

Contents

Methods of Water Quality Assessment: Function of Indicator Systems, different evaluation systems of water quality of running waters, methods of water quality determination according to EU Water Framework Directive, Perlodes, Phylib, fibs
Determination of water quality: Basic knowledge for identification of diatoms, aquatic plants, macrozoobenthos and fish. Determination of water quality with diatoms and macrozoobenthos. Familiarization with methods for assessing water quality with fish and macrophytes. Application of the Perlodes and Phylib assessment systems.

Objective qualification

The students know the different methods of water quality assessment and the general advantages and problems of water quality assessment using indicator organisms. They know the methods of the European assessment systems e.g., according to German Industry Standard (DIN) and especially the EU Water Framework Directive. They have insight into the procedure and background of the assessment and can interpret the assessments correctly. They also have knowledge about different international systems, e.g., the South African Scoring System (SASS). Through the exercise Water Quality Assessment, students gain in-depth knowledge about the analysis of water quality of streams using the recording and determination of indicator organisms (algae, aquatic plants, macroinvertebrates and fish) according to the EU Water Framework Directive. They will be able to correctly apply the different recording methods, have an insight into the determination of organisms and know the determination literature. They can use the necessary software (e.g., ASTERICS, PHYLIB) and interpret the results.

Literature

Wird online zur Verfügung gestellt.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	5,0	Lecture/Exercise	german

Title	Geobotany		
Number	1199960	**Module version**	
Shorttext	GEA-STD-96	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	Fakultät Architektur, Bauingenieurwesen und Umweltwissenschaften
Module duration	2	**Institution**	
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Dietmar Brandes
Workload (h)	180		
Class attendance (h)	84	**Self studying (h)**	96
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
		Exercise	german

Title	Geosphere 3 - Geophysics and Spatial Data Visualization		
Number	1111050	**Module version**	
Shorttext	GEA-IUG-05	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	2	**Institution**	Institut für Geosysteme und Bioindikation
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Antje Schwalb
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination	Written exam (120 Min.)		
Course achievement			

Contents

[Introduction to Geophysics (V)]
- Structure of the Earth, gravitational field, gravimetry
- Earth's magnetic field, magnetics
- Geoelectrics
- Seismology, seismics

[Visualization of geoscientific data (VÜ)]
- Introduction to the application areas of spatial data visualization
- Basics of cartography and remote sensing
- Interpretation of geological maps and profile sections
- Construction of geological profiles
- Spatial work and analyzes with the program ArcGIS
- Visualization and solution of applied questions
- Creation of thematic maps with ArcGIS

Objective qualification

The students acquire knowledge of important geophysical methods such as seismics, magnetics and electricity. Knowledge of possible applications and areas of application within the framework of ecosystem studies.
Furthermore, they are able to create and interpret geoscientific maps, to develop an understanding of the connection between geological processes and geomorphology, and they can visualize a wide variety of geoscientific data. In addition, the students acquire the basic skills of aeronautics and interpretation of satellite images, remote sensing mapping and its application in geoecological studies.

Literature

- Grundlagen der Geophysik, wissenschaftliche Buchgesellschaft, Darmstadt (BERCKHEMER, 1990)
- Einführung in die Geophysik I, B.I. Hochschultaschenbücher (KERTZ, 1969)
- Einführung in die Fernerkundung. Grundlagen von Luft- und Satellitenbildern (ALBERTZ, 1991)
- GIS in Geowissenschaften und Umwelt (ASCH, 1999)
- ArcGIS Spatial Analyst, Geoverarbeitung mit Rasterdaten (MUMMENTHEY, 2012)

-Clauser, C., 2014. Einführung in die Geophysik. Springer.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture/Exercise	german
	2,0	Lecture/Exercise	german
Literature			
Berckhemer, Hans, Grundlagen der Geophysik, Universität Frankfurt. Kertz, Walter, Einführung in die Geophysik I, B-I wissenschaftsverlag.			

Title	Water Management		
Number	4399590	**Module version**	
Shorttext	BAU-STD-31	**Language**	
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	2	**Institution**	Abteilung Hydrologie und Flussgebietsmanagement
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Kai Schröter
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			
Skripte			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture/Exercise	german
	2,0	Lecture/Exercise	german

Title	Modeling of Water-, Energy- and Material Transport in Soils		
Number	1514060	**Module version**	
Shorttext		**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	1	**Institution**	Abteilung für Bodenwissenschaften
Hours per Week / ECTS	4 / 6,0	**Module owner**	Dr. Sascha Iden
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			

Contents

[Modeling water, energy, and matter transport in soil (VÜ)]
-Conceptual and mathematical description of the transport processes of water, energy, gases and solutes by a
combination of the respective flux laws and the principle of local mass conservation, expressed by the continuity
equations for energy and mass.
-Derivation and application of Richards equation, convection-dispersion-equation, gas transport equation and heat flow equation.
-Parametrization of subscale processes and the concept of the REV.
-Parametrization of transport-controlling material functions, e.g. soil water retention curve, unsaturated hydraulic conductivity curve, dependence of thermal conductivity, heat capacity thermal diffusivity, gas diffusion coefficients and reaction parameters on soil water content.
-Analytical and numerical solution of steady-state transport processes in Microsoft Excel and Matlab.
-Introduction to the software packages HYDRUS-1D und HYDRUS-2D/3D and application of these packages to
numerically simulate transient transport processes in soil.
-Simulation projects conducted by student to deepen their understanding.
[Field Experiments in soil hydrology]
-Field experiments for characterizing soil hydraulic properties: tension disc infiltration, well infiltration, double ring infiltration, time domain reflectometry, tensiometer measurements.
-Evaluation of the experiments by applying analytical solutions of the Richards equation, quantification of the results error by error analysis.

Objective qualification

The students
-understand the mathematical and physical description of transport processes in soil and are able to derive the basic model equations for the transport of energy, gases, water and solutes with the continuum approach.
-know how to apply the most important transport models to problems of flow and transport in the unsaturated zone.
-are able to specify appropriate initial and boundary conditions for the governing ordinary and partial differential equations.

-know the most important approaches for the mathematical description of constitutive relationships in soil physics, namely the parametrization of soil hydraulic properties and the water content dependence of transport coefficients (energy, gases, solutes).
-can estimate the typical behavior and intensity of transport processes in the field.
-know how to simulate scenarios of water, energy and matter transport in porous media with the aid of suitable software products.
-are able to systematically analyze the relationship between model inputs and model predictions by means of sensitivity analysis and therefore can assess and judge the information content of transport experiments in the lab and in the field.
-know how to evaluate, interpret, critically judge, present and communicate the results of model simulations.
-know the most important field experiments to determine hydraulic conductivity, are able to conduct them in the field, can analyze the resulting measurement data including an error analysis.

Literature

Hillel, D.: Environmental Soil Physics, Academic Press, San Diego, 1998.
Jury, W.A. und R. Horton: Soil Physics, 6. Auflage. Wiley, New York, 2004.
Radcliffe und Simunek: Soil Physics with HYDRUS - Modeling and Applications, CRC Press, Boca Raton, 2010.

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Related courses

Rules for the choice of courses

Compulsory attendance

Name of the course	SWS	Eventtype	Language
	4,0	Lecture/Exercise	german

Title	Utility and Waste Management		
Number	4306770	**Module version**	
Shorttext	inaktiv	**Language**	german
Frequency of offer		**Teaching unit**	
Module duration	1	**Institution**	Institut für Siedlungswasserwirtschaft
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Thomas Dockhorn
Workload (h)			
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			
Es stehen ausführliche Skripte zur Verfügung.			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture/Exercise	german
Water Supply and Wastewater Management	2,0	Lecture/Exercise	german

Title	Hydraulic Engineering and Water Resources Management		
Number	4306780	**Module version**	
Shorttext	BAU-STD3-7	**Language**	german
Frequency of offer		**Teaching unit**	
Module duration	1	**Institution**	Abteilung Wasserbau und Gewässermorphologie
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Jochen Aberle
Workload (h)			
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination	Written exam (120 Min.)		
Course achievement			

Contents

[Water Management (VÜ)]
Tasks of hydrology and water management; water cycle and water balance of catchment areas; measurement and processing of hydrometeorological data; physical-mathematical models for rainfall-runoff processes; hydrological design of dams; reservoir management; exercises

[Hydraulic Engineering (VÜ)]
Introduction to river science; water level and water surface profile calculation; river training measures; hydraulic structures (weirs, dams; stilling basins); environmental hydraulics; sediment transport; river revitalization; ecological connectivity of rivers; hydropower structures

Objective qualification

The students acquire a basic knowledge of engineering hydrology principles and water management in connection with hydraulic engineering principles and environmentally relevant natural sciences (meteorology, biology, geology, etc.). From a hydrological point of view, the basics of physical-mathematical models are presented so that the students will be able to evaluate hydro-meteorological measurement series of river catchment areas and to establish water balances. Moreover, the students will learn the design principles for water storage structures considering flooding and reservoir management.
From a hydraulic engineering point of view, the students will learn the basic principles for the design and dimensioning of hydraulic structures including dams, weirs, and nature-based solutions. They will be able to calculate open-channel water surface profiles, the conveyance capacity of hydraulic structures, and will acquire the basic knowledge to assess the morphological development of rivers and streams so that they will have the basic understanding to plan and implement hydraulic engineering measures and hydraulic structures.

Literature

Es stehen ein Skript und PC-Arbeitshilfen (Programme, Spreadsheets) zur Verfügung.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture/Exercise	german
	2,0	Lecture/Exercise	german

Title	Modeling of Hydrosystems		
Number	1199910	**Module version**	
Shorttext	GEA-STD-91	**Language**	german
Frequency of offer	only in the summer term	**Teaching unit**	
Module duration	2	**Institution**	Abteilung Hydrologie und Flussgebietsmanagement
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Matthias Schöniger
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			

Anderson, M.P. & Woessner, W.W. (1992): Applied Groundwater Modeling. Simulation of Flow and Advective Transport.- Academic Press, San Diego
Diersch, H-J.G. (2009): Finite Element Subsurface Flow & Transport Simulation System. User´s Manual.- DHI-WASY GmbH, Berlin
Mattheß, G. & Ubell, K. (2003): Allgemeine Hydrogeologie Grundwasserhaushalt.- Lehrbuch der Hydrogeologie Bd. 1, Gebrüder Borntraeger, Berlin
Chiang, W-H. & Kinzelbach, W. (2001): 3-D Groundwater Modeling with PMWIN. A Simulation System for Modeling Groundwater Flow and Polltion.- Springer-Verlag, Berlin
C.W. Fetter (2001): Applied Hydrogeology.- Pearson Education
Istok, J. (1989): Groundwater Modeling by the Finite Element Method.- American Geophysical Union, Water Resources Monograph 13, Washington, D.C.
Kinzelbach, W. & Rausch, R. (1995): Grundwassermodellierung. Eine Einführung mit Übungen.- Gebrüder Borntraeger, Berlin
Hill, M.C. & Tiedemann, C.R. (2006): Effective Groundwater Model Calibration.- With Analysis of Data, Sensitivities,
Predictions, and Uncertainty.- Wiley-Int., New Jersey
Winter, T.C., Harvey, J.W., Franke, O.L. & Alley, W.M. (1998, 2010): Ground Water and Surface Water.- A Single
Resource.- U.S. Geological Survey Circular 1139, Denver
Faunt. C.C. (2009)(ed.): Groundwater Availability of the Central Valley Aquifer, California.- Groundwater Resources Program, Professional Paper 1766, U.S. Geological Survey, Reston

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	4,0	Lecture/Exercise	german

Integrated Modules

Title	Softskills		
Number	1111130	**Module version**	
Shorttext	GEA-IUG-13	**Language**	german
Frequency of offer		**Teaching unit**	Fakultät Architektur, Bauingenieurwesen und Umweltwissenschaften
Module duration	1	**Institution**	
Hours per Week / ECTS	9 / 10,0	**Module owner**	
Workload (h)	270		
Class attendance (h)	80	**Self studying (h)**	190
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			

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Related courses
Rules for the choice of courses
Compulsory attendance

Name of the course	SWS	Eventtype	Language
	2,0	Exercise	german
	2,0	Lecture/Exercise	german
	1,0	Lecture	german

		Lecture	german
		Internship	german
Project Management for Environment and Traffic	2,0	Lecture/Exercise	german

Title	Softskills		
Number	1111130	**Module version**	V1
Shorttext	GEA-IUG-13	**Language**	
Frequency of offer		**Teaching unit**	Fakultät Architektur, Bauingenieurwesen und Umweltwissenschaften
Module duration	1	**Institution**	
Hours per Week / ECTS	9 / 9,0	**Module owner**	
Workload (h)	270		
Class attendance (h)	80	**Self studying (h)**	190
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Exercise	german
	2,0	Lecture/Exercise	german
	1,0	Lecture	german
		Lecture	german
		Internship	german

Project Management for Environment and Traffic	2,0	Lecture/Exercise	german

Title	Data Analysis		
Number	1116210	**Module version**	
Shorttext	GEA-UA-18	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	2	**Institution**	Abteilung für Landschaftsökologie und Umweltsystemanalyse
Hours per Week / ECTS	6 / 8,0	**Module owner**	Prof. Dr. Boris Schröder-Esselbach
Workload (h)	240		
Class attendance (h)	84	**Self studying (h)**	156
Compulsory requirements			
Expected performance/ Type of examination	Written exam (120 Min.)		
Course achievement	Portfolio		

Contents

[Basics of Statistics (Lecture, Exercise)]
Scales, measures of location and dispersion, covariance and correlation, probability theory, distributions in general, binomial and normal distribution, estimation procedures, testing in general, t-test, U-test, analysis of variance, linear regression, in general and generalised linear models.

[Geostatistics (Lecture, Exercise).
Interpolation methods, stochastic processes, stationarity, variogram analysis, Kriging methods.

Objective qualification

The aim is to understand the basics of descriptive and inferential statistics, simple statistical modelling and geostatistical methods. The freely available program R is used (cran.r-project.org).

The students learn to
1. prepare data in a suitable way descriptively and graphically,
2. select suitable estimation and test procedures
3. interpret the results of these procedures correctly and to create and interpret simple models to describe relationships.
in "Geostatistics", they learn to
4. prepare spatial data descriptively and graphically
5. investigate spatial dependencies, and to
6. use these dependencies for interpolation.

Literature

Michael J. Crawley (2005): Statistics - An Introduction using R, Wiley Inc.
Lothar Sachs (2004): Angewandte Statistik, Springer Verlag.
Ralf Lorenz (1996): Grundbegriffe der Biometrie, Gustav Fischer Verlag.
Peter Dalgaard (2008): Introductory Statistics with R, Springer Verlag.

R. Roger S. Bivand, Edzer Pebesma and V. Gómez-Rubio (2013) Applied Spatial Data Analysis. UseR! Series, Springer

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Lecture/Exercise	german
	4,0	Lecture/Exercise	german

Title	Geoecological Project Seminar		
Number	1111020	**Module version**	
Shorttext	GEA-IUG-02	**Language**	german
Frequency of offer	only in the summer term	**Teaching unit**	
Module duration	1	**Institution**	Institut für Geosysteme und Bioindikation
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Antje Schwalb
Workload (h)	180		
Class attendance (h)	56	**Self studying (h)**	124
Compulsory requirements			
Expected performance/ Type of examination	Presentation with a report (50% presentation, 50% report)		
Course achievement			

Contents

In this integrated geoecological course, geology and geomorphology, soils, hydrological situation, hydrogeology, geobotany and landscape ecology, including land use are recorded for a specific landscape area. Preparatory seminar: Students prepare and give short lectures based on literature studies and submit short reports. 6 field days: thematic working groups prepare, whereever possible, thematic maps (e.g. geological subsoil, soil, morphology, land use, ground and surface water, anthropogenic changes, climate). This is followed by work in the laboratory, as well as reporting and presentation of results. Rock, soil and water samples are characterized using routine methods (DIN or EN). Other problems (e.g. exposure, insolation, etc.) are dealt with in the computer pool. Data is evaluated together with the results from field surveys and summarized in a written report. An oral presentation of the results of each individual group concludes the course.

Objective qualification

Ability to quickly grasp the basic features of the complex system of a landscape. Integrated recording of landscape features and training to geo-ecologically assess the status quo of a compartment of a landscape and to assess the consequences of land use.

Ability to recognize and investigate environmental problems, and to work out solutions.

Literature

Je nach Schwerpunkt wird den Studierenden vom verantwortlichen Dozenten entsprechende Literatur zur Verfügung gestellt.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	4,0	Seminar	german

Title	Geoecological Seminar and Excursion		
Number	1514180	**Module version**	
Shorttext	PHY-IGÖ-18	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	2	**Institution**	Abteilung für Landschaftsökologie und Umweltsystemanalyse
Hours per Week / ECTS	4 / 6,0	**Module owner**	Prof. Dr. Boris Schröder-Esselbach
Workload (h)	180		
Class attendance (h)	70	**Self studying (h)**	110
Compulsory requirements			
Expected performance/ Type of examination	Seminar: Term paper (75%)		
Course achievement	Excursion: 25%		

Contents

Geoecological Seminar – Scientific Writing
Correct structure of theses and publications; title, abstract, introduction, materials & methods, results with tables and figures, discussion, conclusion, literature cited; techniques and tips for the design of tables and figures, structure of paragraphs, active and concise style of writing

Geoecological Excursion:
Description and analysis of geological-mineralogical, pedological, climatological, micrometeorological, vegetational, faunal, hydrological and socio-geographic characteristics of various landscapes during the field excursion. Along a geological and/or climatological gradient, various landscapes will be analyzed and characterized by means of preliminary information, maps, local observation and sampling. The multidisciplinary approach to landscapes and to the anthropogenic impact are of particular importance.

Objective qualification

Geoecological Seminar – Scientific Writing
The students learn to write a scientific publication. In a stepwise approach, this interactive seminar teaches how to structure theses or scientific manuscripts according to the AIMRAD standard. The students will acquire the ability to design informative tables and figures, to structure paragraphs in a meaningful way, to compose concise sentences and to present data in an objective way and correct context. In small homework assignments, the students practice to write each of the components of a scientific manuscript in the realm of geoecology. In the seminar, they actively discuss correct and faulty implementation.

Geoecological Excursion:
After successfully completing this excursion, the students will know and understand the most important factors and relationships that characterize a landscape from a geoecological perspective. This includes: the combined effects of climate and endogenous, geological-mineralogical parameters on the shape and surface of a landscape, the soil formation, local meteorological and hydrological conditions, the vegetation and other biological systems as well as various anthropogenic ways of land use. Contextually, the students understand the historic development of land use. They are able to recognize and evaluate the present and prospective approaches to land use as well as the potential risks to natural landscapes resulting from natural changes or manmade interventions.

Literature
Je nach Schwerpunkt wird den Studierenden vom verantwortlichen Dozenten entsprechende Literatur zur Verfügung gestellt.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Seminar	german
	2,5	Excursion	german

Title	GIS and Environmental Informatics		
Number	4398430	**Module version**	
Shorttext		**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	2	**Institution**	Institut für Geodäsie und Photogrammetrie
Hours per Week / ECTS	4 / 5,0	**Module owner**	Prof. Dr. Markus Gerke
Workload (h)	150		
Class attendance (h)	56	**Self studying (h)**	94
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			
Wird in Vorlesung erörtert.			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Exercise	german
	2,0	Lecture	german

Title	Environmental Systems		
Number	1116230	**Module version**	
Shorttext	GEA-UA-03	**Language**	german
Frequency of offer	only in the winter term	**Teaching unit**	
Module duration	2	**Institution**	Abteilung für Landschaftsökologie und Umweltsystemanalyse
Hours per Week / ECTS	6 / 7,0	**Module owner**	Prof. Dr. Frank Suhling
Workload (h)	210		
Class attendance (h)	70	**Self studying (h)**	140
Compulsory requirements			
Expected performance/ Type of examination	Written exam (90 Min.) or Term paper		
Course achievement			

Contents

[Tools of Scientific Computing (Exercise)]
- Introduction to R
- Introduction to Algorithmics
- Introduction to difference and differential equations
- Simple Numerical Methods for Solving DGL (Iteration, Recursion)
- Simple population dynamic models

[Modelling of Environmental Processes (Lecture & Exercise)]
- Introduction to descriptive models
- Modelling approaches from landscape ecology that help to describe fragmentation patterns, population dynamics and distribution patterns of individual species
- Stability analysis of simple dynamic systems
- Introduction to models of spatial population dynamics
- Introduction to methods of systems analysis: steady states, stability analysis

Objective qualification

The students acquire the methodological competence to map environmental processes into mathematical models in the form of differential equations, among others, to formulate initial value problems, and to solve them numerically by using freely available software (R). They are also enabled to apply methods of landscape ecological modelling, to visualise and interpret data and models, to check the underlying assumptions and to critically evaluate the models and their scope of application

Literature

Mathiopoulos, J., 2011. How to be a quantative ecologist. Wiley, Chichester.

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**
	2,0	Exercise	german
	3,0	Lecture/Exercise	german

Professional Practical Training

Title	Professional Practical Training		
Number	1199930	**Module version**	
Shorttext	GEA-STD-93	**Language**	german
Frequency of offer	every term	**Teaching unit**	Fakultät Architektur, Bauingenieurwesen und Umweltwissenschaften
Module duration	1	**Institution**	
Hours per Week / ECTS	0 / 8,0	**Module owner**	
Workload (h)	240		
Class attendance (h)	0	**Self studying (h)**	240
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**

Bachelor's Thesis

Title	Bachelor's Thesis		
Number	1199240	**Module version**	
Shorttext	GEA-STD-24	**Language**	german
Frequency of offer	every term	**Teaching unit**	Fakultät Architektur, Bauingenieurwesen und Umweltwissenschaften
Module duration	1	**Institution**	
Hours per Week / ECTS	0 / 12,0	**Module owner**	
Workload (h)	360		
Class attendance (h)	1	**Self studying (h)**	359
Compulsory requirements			
Expected performance/ Type of examination			
Course achievement			
Contents			
Objective qualification			
Literature			

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Related courses			
Rules for the choice of courses			
Compulsory attendance			
Name of the course	**SWS**	**Eventtype**	**Language**