2016/2017

MATHEMATISCH-
NATURWISSENSCHAFTLICHE
FAKULTÄT

MEDIZINISCHE
FAKULTÄT

PHILOSOPHISCHE
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RECHTSWISSENSCHAFTLICHE
FAKULTÄT

WIRTSCHAFTS- und
SOZIALWISSENSCHAFTLICHE
FAKULTÄT

UNIVERSITÄT ZU KÖLN

MODULE HANDBOOK

INTERNATIONAL MASTER OF ENVIRONMENTAL SCIENCES (IMES)

MASTER OF SCIENCE

IN ACCORDANCE WITH THE EXAMINATION PROTOCOL FOR THE IMES COURSE OF STUDY

SUBJECT TO REVIEW BY DEPARTMENT 23 FOR SPECIAL STUDENT AFFAIRS OF THE UNIVERSITY OF COLOGNE AND POSSIBLY GENERAL COUNSEL OF THE UNIVERSITY

Universität zu Köln

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Legend

AM	Aufbaumodul/Advanced Modules
BM	Basismodul/Basic Modules
EX	Exkursion/Excursions
K	Kontaktzeit (= Präsenzzeit in LV). Contact Time (Presence required in class)
LP	Leistungspunkt (engl.: CP)
LV	Lehrveranstaltung/Class
P	Pflichtveranstaltung/Mandatory Class
W	Wahlveranstaltung/Elective Class
S	Semester
SoSe	Sommersemester/Summer Semester
SWS	Semesterwochenstunde/Semester Weekly Hour
Ü	Übung/Practical Session
VN	Selbststudium/Self Study
WiSe	Wintersemester/Winter Semester

Table of Contents

1. The International Master of Environmental Sciences

All around the planet, humans have had an effect on the evironment; they have significantly damaged it and exploited natural resources far beyond their capacity for regeneration. Even in the most remote parts of Antarctica chemical remnants due to human activity have been found. Humans are dependent for their survival, however, on a properly functioning environment. For this reason, a strong interest in environmental sciences can be seen today. This interest is aimed at supporting the preservation of the environment and, as such, the natural basis for our livelihood.

Obtaining a fundamental understanding of many of the issues confronting the environment is only possible by studying the interaction between human activity and natural ecosystem processes. Through an interdisciplinary approach, this course of study shall pursue the goal of connecting the various subdivisions of the environmental sciences (natural science foundations, legal frameworks, social and economic consequences of human activity, health implications) as well as environmental education, with one another in order to be able to solve environmental problems in the context of various disciplines.

1.1 Content, Study Objectives and Requirements

Content:

The four-semester course of study imparts knowledge in the area of natrual and social sciences in connection with environmental sciences. A series of interdisciplinary courses shall link the individual modules and courses with one another. An international setting is attained by having a significant contingent of foreign students. Further, the course of study aims to integrate a wide spectrum of domestic and foreign guest lecturers into the teaching, which is conducted in English.

Depending on the direction they intend to take in their careers, as well as their personal inclinations, students develop an individual profile through the selection of their modules. A master’s thesis is completed within those selected areas. A series of excursions supplements the seminars and provide practical insight into possible areas of work in the field of environmental sciences. In addition, the course of study endeavors to impart skills in the areas of methods and scientific writing and presentation. Semesters abroad and internships are not a part of the official study schedule, but may individually be integrated into the course of study.

Study Objectives:

The IMES program, with the degree of Master of Science (MSc), equips students with the ability to engage in independent scientific work, to analyze and critically evaluate scientific findings in the field of environmental sciences, to apply in a targeted manner scientific working methods and to deal with complex interdisciplinary problems taking into consideration their societal and natural science aspects. Further, students are made competent in the areas of scientific writing, presentation and project organization. The international aspect of the program requires an advanced level of social skills, which imparts to the students the basic requirement of being able to successfully work in an international context. The approach, which has both research and career oriented, and the individual area

of concentration in the masters program are essential requirements for the successful placement of graduates in the diverse employment fields within the environmental science.

Requirements:

The admissions requirements can be found in the Admissions Protocol.

1.2 Program Structure and Schedule

a) 1st and 2nd Semester

In the first phase, interdisciplinary foundations are taught over two semesters in base modules specific to the course of study. These can be freely chosen by the students. However, in the first two semesters, at least one module in the area of natural and social sciences must be taken in each. In order to attain the required minimum of 30 credit points each, at least one additional module must be chosen based on individual interest. The lectures offered in the first semester and the methods courses in the second semester are mandatory. Further, students are offered excursions and seminars on scientific work, which are likewise mandatory.

b) 3rd Semester

In the second phase, students are offered the opportunity to specialize in subareas of the environmental sciences and may choose two subjects from the areas of the natural or social sciences. A concentration in only natural or social sciences is generally possible. In this phase, practical foundations, in particular, are imparted in order to be able to deal independently and in a problem-oriented manner with environmental issues. It is in this manner that students are prepared to work in interconnected projects at the intersections of society and environment.

In addition, there is a mandatory seminar in the area of advanced environmental sciences. Based on the technical knowledge learned in the prior semesters, students shall be provided additional explanation of the interrelationships across disciplines.

c) 4th Semester

The 3rd phase of the program consists of the preparation of a master’s thesis extending over the period of one semester and is completed with an oral final examination. In addition to student guidance by a professor, participation in a master’s colloquim is mandatory. This is meant to ensure that students receive regular feedback on their work and that questions regarding the preparation of the thesis can be answered on a timely basis.

1.3 Credit Points Overview

Credit Points Overview and Semester Weighting in the Overall Grade		
Professional studies: 1st Semester	30 points	25 %
Professional studies: 2nd Semester	30 points	25 %
Professional studies: 3rd Semester	30 points	25 %
Master's Thesis: 4th Semester	30 points	25 %
Total	**120 points**	**100%**

1.4 Course Overview

	Credit Points Overview					
S	**Module**	**Type**	**Class Time (h)**	**Self Study (h)**	**Credit Points**	**Page**
1-2	**Introduction to Natural and Social Sciences and Excursions**	P	60	120	6	5
1-2	**Meteorology (Atmosphere I)**	W	60	120	6	7
1	**Atmospheric Chemistry (Atmosphere II)**	W	60	120	6	8
1-2	**Ecology (Biosphere)**	W	60	120	6	10
1-2	**Geosphere**	W	60	120	6	12
1	**Hydrology**	W	60	120	6	13
2	**Environmental Economics**	W	60	120	6	15
1-2	**Environmental Medicine**	W	60	120	6	17
1-2	**Environmental Law**	W	60	120	6	19
1-2	**Environmental Politics**	W	60	120	6	21
1	**Environmental Management**	W	30	60	3	24

1	**Environmental Sociology**	W	30	60	3	26
1-2	**Anthropology**	W	60	120	6	28
1-2	**Education**	W	60	120	6	30
2	**Geographic Information Systems**	W	30	60	3	31
1	**Introduction to Environmental Statistics**	W	30	60	3	33
1	**Introduction to Environmental Chemistry**	W	30	60	3	34
1-4	**Supplementary Work Shops: Soft Skills and Science and Communication**	W				35
3	**Integrated Advanced Module in Environmental Sciences**	P	60	120	6	36
3	**Advanced Module Atmosphere**	W	120	240	12	38
3	**Advanced Module Biosphere**	W	120	240	12	40
3	**Advanced Module Geosphere**	W	120	240	12	42
3	**Advanced Module Hydrosphere**	W	120	240	12	44
3	**Advanced Module Environmental Law**	W	120	240	12	46
3	**Advanced Module Environmental Policy and Management**	W	120	240	12	48
3	**Advanced Module Political Ecology & Environmental Governance**	W	120	240	12	50
3	**Advanced Module Environmental Spatial Methods**	W	120	240	12	51
4	**Master Thesis**	P			30	54

2. Modul Description

2.1 Basic Modules

<table>
<tr><td colspan="7">Basic Module: Introduction to Natural and Social Environmental Sciences and Excursions</td></tr>
<tr><td colspan="2">Code Number:
MA-IMES-B-INT</td><td>Workload:
180 h</td><td>Credit Points:
6</td><td>Term:
1. Sem.</td><td>Frequency:
WiSe</td><td>Duration:
1 Semester</td></tr>
<tr><td>1</td><td colspan="3">Title:
a) Introduction to Natural and Social Environmental Sciences
b) Excursions</td><td>Contact Time:
2 SWS / 30 h</td><td>Self-study:
60 h</td><td>Size:
30</td></tr>
<tr><td>2</td><td colspan="6">Goals of qualification:
a) After the module the students…
…should be able to explain the character of “science” in both natural and social sciences.
...should have a general understanding of environmental sciences and be able to define the different disciplines which constitute it. This should include that students understand how environmental sciences are structured and how the different disciplines are linked to each other.
…should also have an understanding of the historical developments of environmental sciences and what kind of ethic question in the human/environment relations occur.
…should be able to understand and explain basic terms such as “sustainable development” and resilience.
…should know practical examples and main challenges for each discipline.
c) Introduction to practical work in the field of environmental sciences.</td></tr>
<tr><td>3</td><td colspan="6">Contents:
a) • Environmental Sciences: General definitions, interdisciplinary and basic terms
• Historical developments of environmental sciences
• Environmental Ethics (Relationship between humans and the environment)
• Introduction to the disciplines constituting environmental sciences: anthropology,</td></tr>
</table>

	ecology, meteorology, hydrology, geosphere, geophysics, environmental politics, etc. b) The students are required to participate in six excursions during the winter and summer term. The excursions will take place in the greater region of Cologne and cover different areas related to environmental sciences.
4	**Type of Course:** Lecture and Excursion
5	**Status of the Module in the Program:** Obligatory Module in the IMES-Program
6	**Requirements for Participation:** None
7	**Type of Examination:** a) The dates of the written exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Written Exam and one briefing for one of the excursions. Subject of examination: the contents of the lectures of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module part has been successfully completed with the minimum grade sufficient (4.0) and the students participated in six excursions/submitted one briefing. The briefing itself will receive no grade but comments for an improved briefing drafting will be given to the student.
9	**Significance of the Grading in the Final Grade:** 5% (6 LP)
10	**Person in Charge:** a) N.N. b) Academic Manager of IMES
11	**Other Information:** None

Basic Module: Meteorology (Atmosphere I)					
Coad Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-B-At1	180 h	6	1. Sem.	WiSe	2 Semester

1	**Title:**	**Contact Time:**	**Self-study:**	**Size:**
	a) General Aspects of Meteorology	2 SWS / 30 h	60 h	30
	b) Introduction to Synoptic Meteorology	2 SWS / 30 h	60 h	30

2 **Goals of qualification:**

a) and b) To get an insight in fundamental physical principles upon which atmospheric sciences are based. Basic knowledge in thermodynamics of the atmosphere, some dynamics of the atmosphere, global circulation, technics of weather prediction an remote sensing and atmospheric chemistry and air pollution.

3 **Contents:**

a) In the lecture, fundamental physical principles upon which atmospheric sciences are based will be introduced. The goal is to provide an elementary description and interpretation of a wide range of atmospheric phenomena. Main topics are a survey of the atmosphere including measurement devices, basic laws describing the atmosphere, a fundamental understanding of synoptical weather systems including numerical weather predictions and aspects of remote sensing.

4 **Type of Course:**

Seminar, Lecture

5 **Status of the Module in the Program:**

Compulsory Module Choice

6 **Requirements for Participation:**

None

7 **Type of Examination:**

The dates of the written exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Exam. Subject of examination: the contents of the lectures

	(a and b) of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module has been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 5% (6 LP)
10	**Person in Charge:** a) Prof. Dr. Yaping Shao, Universität zu Köln - Institut für Geophysik und Meteorologie
11	**Other Information:** None

Basic Module: Atmospheric Chemistry (Atmosphere II)					
Code Number: MA-IMES-B-At2	**Workload** 180 h	**Credits** 6	**Term** 1. Semester	**Frequency** WiSe	**Duration** 1 Sem
1	**Type of lessons** **a) Lectures** **b) Exercises**	**Contact time** 30 h 30 h	**Self-study times** 60 h 60 h	**size** 30	
2	**Aims of the module and acquired skills** ▪ Comprehension of how physical/chemical processes affect composition and changes of the atmosphere ▪ Knowledge of several trace substance cycles ▪ Comprehension of spatial and temporal gradients of trace substances ▪ Application of reaction mechanisms on the decomposition of trace substances ▪ Acquired skills are computer practice, general comprehension of systems, critical assessment and discussion of scientific work				
3	**Contents of the module** • Chemical elementary reactions • Chemical composition of the atmosphere • Simple reaction systems • Chemical and atmospheric persistence • Photochemistry • Biogenic and anthropogenic emissions • Atmospheric deposition processes				

	• Climate efficiency of trace gases • Aerosol chemistry and physics • Atmospheric distribution of trace substances • Trace substance cycles of CO, methane, hydrocarbons, sulfur compounds, nitric oxides • Chemistry of the hydroxyl radical • Complex ways of decomposition of trace substances • Photochemistry of the decomposition of trace substances, radical cycles • Formation of ozone in the troposphere • Trace substance balance, troposphere, stratosphere • Stratospheric ozone chemistry • Climate development
4	**Teaching/Learning methods** Lectures and tutorials
5	**Requirements for participation** None
6	**Type of module examinations** Written examination (graded).
7	**Requisites for the allocation of credits** Successful participation in the exercises (50 % of the possible points have to be obtained) and passing of the examination. At the end of the semester or to the beginning of the following semester a possibility to repeat the examination is offered. A failed examination may be repeated twice. Additional possibilities to repeat an examination exist taking into account the “Joker” and the “Aces” according to the examination regulations (§ 20 section 2). Assessments which have been passed are not allowed to be taken again. There is an exception: If at the end of a module which consists of a lecture and tutorial classes, the student takes the assessment at the first available date after having received admission to the module exam, he/she is then allowed to take the assessment again at the next available date for the purpose of improving the grade, even if he/she passed the assessment the first time – in this case, the better of the two grades will count towards the final degree grade (§ 20 section 7). The exam grade is the module mark. In the case of two passed exams the better grade is the module mark.
8	**Compatibility with other Curricula** - Other modules of equal value can be admitted and announced by the examination board after agreement. - Suitable as an elective course for mathematics, physics and geoscience students
9	**Significance of the module mark for the overall grade** 5% (6 LP)
10	**Module coordinator** A. Wahner, T. Mentel

11	**Additional information** The “Forschungszentrum Jülich” is offering every year internships to IMES students. These internships can be chosen as a third term module during the third term. IMES students will be involved in running research projects. Further information will be given by the module coordinator during the lectures.

Basic Module: Ecology (Biosphere)					
Code Number: MA-IMES-B-Bio	**Workload:** 180 h	**Credit Points:** 6	**Term:** 1. Sem.	**Frequency:** WiSe	**Duration:** 2 Semester
1	**Title:** a) Ecology I b) Ecology II		**Contact Time:** 2 SWS / 30 h 2 SWS / 30 h	**Self-study:** 60 h 60 h	**Size:** 30 30
2	**Goals of Qualification:** a) Understanding general ecological principles, overview on aspects of autecology, population ecology, community ecology and ecosystem ecology. Ability to identify and work on issues in applied ecology and environmental science based on knowledge from ecological processes and patterns.				
3	**Contents:** a) The basics of ecology are taught including the microbiological, botanical and zoological aspects of the factors determining the abundance and distribution of organisms. All aspects are discussed in the context of applied issues: Methods of ecological research incl. theoretical methods and hypotheses oriented studies. Nature of complexity of interactions. Basic abiotic factors characterising the different regions of the biosphere. Physiological ecology of adaptations to environmental conditions. Population ecology incl. intra- and interspecific interactions of organisms, population dynamics, life history strategies, and productivity on different trophic levels. In the second part, the lecture focuses on community ecology and ecosystem ecology (competition, predator-prey interactions, diversity, food-web organization, flow of energy and material). Environmental case studies are used to illustrate these concepts: invasion of exotic species (dispersal), climate change (auto ecology and biogeography), pest control (trophic interactions), fisheries and overexploitation (food web organization), bio monitoring (auto ecology).				

4	**Type of Course:** Seminar, Lecture
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the written exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Exam. Subject of examination: the contents of the lectures (a and b) of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module has been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 5% (6 LP)
10	**Person in Charge:** a) Prof. Dr. Hartmut Arndt, Universität zu Köln – Zoologisches Institut
11	**Other Information** None

<table>
<tr><td colspan="7">Basic Module: Geosphere</td></tr>
<tr><td colspan="2">Code Number:
MA-IMES-B-Geo1</td><td>Workload:
180 h</td><td>Credit Points:
6</td><td>Term:
1. Sem.</td><td>Frequency:
WiSe</td><td>Duration:
2 Semester</td></tr>
<tr><td>1</td><td colspan="3">Title:
a) Introduction to Environmental Geophysics (WiSe)
b) Landscape Formation (SoSe)</td><td>Contact Time:
2 SWS / 30 h
2 SWS / 30 h</td><td>Self-study:
60 h
60 h</td><td>Size:
30
30</td></tr>
<tr><td>2</td><td colspan="6">Goals of qualification:
a) The main goal is the understanding of basic concepts, methodology and interpretative procedures of the applied geophysical methods used in the environmental studies.
b) Knowledge and understanding of the factors, dynamics and outputs of landscape evolution with special regard to the Quaternary and the interaction of natural phenomena and human activities.</td></tr>
<tr><td>3</td><td colspan="6">Contents:
a) The lecture will give a general introduction to the most important methods of geophysical exploration. These methods represent a primary tool for the investigation of the subsurface and are consequently very important for environmental scientists. Several aspects of the various survey methods such as the physical principles, methodology, interpretative procedures and fields of environmental application will be discussed, the main emphasis being placed on electromagnetic and seismic methods as the most intensively used techniques. The main goal of the lecture is to demonstrate the possibilities of applied geophysics in the assessment of environmental risk.
b) The lecture will address the fundamental factors, dynamics and outputs of landscape evolution. Special focus is driven to relief-forms (their morphography, morphometry, morphodynamics and morphochronology) as they are fundamental control factors in each ecosystem. Beside the natural landscape formation, the effects of human activities (e.g. technical landforms) and of climate change on (catastrophic) geomorphological processes (e.g. floods and landslides) will be demonstrated.</td></tr>
<tr><td>4</td><td colspan="6">Type of Course:
Lecture</td></tr>
<tr><td>5</td><td colspan="6">Status of the Module in the Program:</td></tr>
</table>

	Compulsory Module Choice
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the written exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Written exam. Subject of examination: the contents of the lectures (a and b) of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module has been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 5% (6 LP)
10	**Person in Charge:** a) Prof. Dr. Bülent Tezkan, Universität zu Köln - Institut für Geophysik und Meteorologie b) Prof. Dr. Helmut Brückner, Universität zu Köln – Geographisches Institut
11	**Other Information** None

Basic Module: Hydrology					
Code Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-B-Geo2	90 h	3	1. Sem.	WiSe	1 Semester
1	**Title:**		**Contact Time:**	**Self-study:**	**Size:**
	b) Physical Hydrology (WiSe)		2 SWS / 30 h	60 h	30

2	**Goals of Qualification:** a) Understand the underlying concepts of hydrology and gain an understanding of hydrological methods used in water resources management. Based upon the understanding of processes, which govern of water fluxes and water storages, as well as the methods available to gain qualitative information about our water resources, the students will learn to assess the potentials and limits of different water uses. Hydrological processes are discussed particularly with respect to issues of water resources management. Building upon the thorough understanding of physical hydrological processes, methods and options of integrated water resources management are discussed in follow up courses of the 3rd semester.			
3	**Contents:** a) The lecture provides an introduction to terrestrial physical hydrology. The focus will be on quantitative aspects of hydrology. Students will learn about basic hydrological concepts such as the water cycle on different spatial scales (global hydrological cycle to plot scale), various fluxes of water as well as water storage terms on the land surface. They will obtain an understanding and appreciation of hydrology as a quantitative science describing the occurrence, distribution and movement of water at and near the surface of the earth. The impact of different environmental properties on the water availability and parameters used to determine these fluxes will be discussed. Fundamental methods and concepts to describe, measure and model these fluxes will be presented. Based upon the discussion of the hydrological principles and physical laws, students should be able to develop a sound understanding of the physical processes involved in the land phase of the hydrologic cycle. This will provide a framework to derive temporal and spatial distribution of the available water resources and the foundation to determine opportunities and limits of sustainable use of available water resources. As water is a key environmental resource, which determines and limits future development possibilities, a sound knowledge of physical terrestrial hydrology is crucial for future decision makers. While this lecture focuses on the aspects of physical hydrology, a multitude of cross references and implications to environmental problems as well as applied issues of environmental management are obvious, since water is a key substance for environmental processes and well as social and economic issues such as water environmental management. The participants are required to prepare the classroom meetings prior to each session based upon the teaching material presented on the e- learning platform ILIAS. This enables the students to follow the explanations and to pose relevant questions.			
4	**Type of Course:**			

	Lecture
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the written exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Written exam. Subject of examination: the contents of the lectures (a and b) of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module has been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 2,5% (3 LP)
10	**Person in Charge:** a) Prof. Dr. Karl Schneider, Universität zu Köln – Geographisches Institut
11	**Other Information** None

Basic Module: Environmental Economics					
Coad Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-B-Eco	180 h	6	2. Sem.	SoSe	1 Semester
1	**Title**		**Contact Time**	**Self-study**	**Size**
	a) Energy, Resources, Environment, and the Economy (SoSe)		4 WS / 60 h	120	60

2	**Goals of qualification:** a) Students get a general understanding of energy, resource, and environmental economics which is a central asset while working in media, banks, research institutes and the public and private sector. The course prepares students for further research in that academic area. The institutional framework of the subject will be explained and presented. Based on empirical and theoretical literature students will analyse the topic and will be encourages to discuss the papers critically.			
3	**Contents:** * Basic technical and energy economic principles * Energy markets * Resource economy * Environmental economy			
4	**Type of Course** Lecture, Seminar			
5	**Status of the Module in the Program:** Compulsory Module Choice			
6	**Requirements for Participation** None			
7	**Type of Examination:** The dates of the written exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Exam. Subject of examination: the contents of the lectures of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.			
8	**Requirements for allocation of credit points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).			
9	**Significance of the grading in the final grade** 5% (6 LP)			
10	**Person in Charge:** PD Dr. Lindenberger – Energiewirtschaftliches Institut der Universität zu Köln			

11	**Other Information** Based on the availability of courses, a third term module is possible. Further information will be given during the lecture.

Basic Module: Environmental Medicine					
Code Number: MA-IMES-B-Med	**Workload:** 180 h	**Credit Points:** 6	**Term:** 1. and 2. Sem.	**Frequency:** WiSe/SoSe	**Duration:** 2 Semester
1	**Title:** a) Environmental Medicine I b) Environmental Medicine II		**Contact Time:** 2 SWS / 30 h 2 SWS / 30 h	**Self-study:** 60 h 60 h	**Size:** 30 30
2	**Goals of Qualification:** a) b) Students are introduced to the study and assessment of the impacts of physical, chemical, and biological agents in the environment on human health and disease and to means for their measurement and control.				
3	**Contents:** In the course of 2 integrative semesters, Environmental Medicine I and II prepare students to study and assess the impacts of physical, chemical, and biological agents in the environment on human health and disease and introduce means for their measurement and control. The curriculum is syndisciplinary, including environmental medicine and epidemiology, toxicology, hygiene, and risk assessment. a) Environmental Medicine I places emphasis on: • global threats: past and current • information resources • human physiology • statistical methods • study designs • waterborne diseases, • airborne diseases, • risk assessment and public health. b) Environmental Medicine II places emphasis on:				

	• statistical methods • study designs • water- and airborne diseases, • ionizing radiation, • non-ionizing radiation, • skin and environment, • preventive and interventive research, • risk assessment and public health.
4	**Type of Course:** Lecture
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the written exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Exam. Subject of examination: the contents of the lectures (a and b) of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module has been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 5% (6 LP)
10	**Person in Charge:** a) b) Prof. Dr. Thomas Erren, Universität zu Köln - Institut und Poliklinik für Arbeits- und Sozialmedizin
11	**Other Information** None

<table>
<tr><td colspan="7">Basic Module: Environmental Law</td></tr>
<tr><td colspan="2">Code Number:
MA-IMES-B-Law</td><td>Workload:
180 h</td><td>Credit Points:
6</td><td>Term:
1. and 2. Sem.</td><td>Frequency:
WiSe/SoSe</td><td>Duration:
2 Semester</td></tr>
<tr><td>1</td><td colspan="3">Title:
a) Introduction to Comparative Environmental Law
b) Introduction to International Environmental Law</td><td>Contact Time:
2 SWS / 30 h
2 SWS / 30 h</td><td>Self-study:
60 h
60 h</td><td>Size:
30
30</td></tr>
<tr><td>2</td><td colspan="6">Goals of Qualification:
a)
Learn to identify and understand domestic sources of environmental law, institutions of environmental law, and subjects of environmental law.
Learn the basics of finding domestic sources of environmental law.
Learn the advantages and disadvantages of comparativism.
Learn to distinguish law from politics.
Learn the basics of environmental legislation, interpretation and execution.
Learn how environmental law builds upon, and contributes to, other social sciences as well as the natural sciences.
b)
Learn to distinguish international public environmental law from politics.
Learn the basics of international environmental legislation, interpretation and execution.
Learn how international environmental law builds upon, and contributes to, other social sciences as well as the natural sciences.
Learn to identify and understand international sources of environmental law, institutions of environmental law and subjects of environmental law and to distinguish them and their functions from the domestic ones.
Learn how international environmental law has been used to solve environmental problems.
Learn to distinguish the solutions to environmental problems offered by international law from those offered by domestic law.</td></tr>
<tr><td>3</td><td colspan="6">Contents:
a) This Module will introduce the student to the discipline of law. Focus will be</td></tr>
</table>

	upon domestic legal systems, and upon recognizing where environmental law fits within domestic legal systems. To achieve the learning goals, students will learn how environmental problems were, and still are, solved through the law before and after the introduction of dedicated environmental legislation. Students will be introduced to domestic sources, institutions and subjects of law. Students will be introduced to the concept of sources of law as the basics of finding applicable law to a problem. b) This Module will introduce the student to international law, building upon the first semester's understanding of domestic law. Focus will be upon distinguishing international sources, institutions and subjects from domestic ones, and upon distinguishing international public law from politics. Treaties will be studied in the categories of the natural sciences: atmosphere, hydrosphere and geosphere. Cases of litigation and arbitration will be studied to determine international customs and principles.
4	**Type of Course:** Lecture
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** a) None b) While there is no formal requirement, International Environmental Law will be taught assuming the student has a basic understanding of sources of law, institutions of law and subjects of law, however that understanding was achieved.
7	**Type of Examination:** a) Students will independently research and write a paper outside of the lectures in which the student presents an environmental problem in a country of his or her choice, presents that country's official state policy on the problem, presents the sources and institutions of law on that problem in that country, and then assesses whether those laws and institutions solve the problem. The student will then do the same for a second country of choice. The paper will then build a matrix by which one can compare the performance of the first country's environmental solutions with the second. Date for completion will be after in-class examinations for the semester are complete. Enrollment for the paper will be the date on which the paper is due. Re-examination will follow the exam regulations and may include other types of examination. b) The preferred type of examination will be to assign case studies of international environmental law to teams of students consisting of students of natural and social sciences, and may include law students. The team of multi-disciplinary students will research the problem from his or her disciplinary perspective and present the research to other members of the group. Each member of the group is then responsible

	to write a paper independently using the research learned from the others. Re-examination will follow the exam regulations and may include other types of examination. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when the examinations of the module has been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 5% (6 LP)
10	**Person in Charge:** a) b) Prof. Dr. Kirk Junker, Universität zu Köln – Lehrstuhl für US-amerikanisches Recht
11	**Other Information** None

Basic Module: Environmental Politics

Code Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-B-Pol	180 h	6	1. and 2. Sem.	WiSe/SoSe	2 Semester

1	**Title and Term:**	**Contact Time:**	**Self-study:**	**Size:**
	a) EU Environmental Policy and Policy Making (WiSe)	2 SWS / 30 h	60 h	30
	b) Political Ecology (SoSe)	2 SWS / 30 h	60 h	30

2	**Goals of Qualification:** a) Key course objectives are to: • introduce students to key elements of EU environmental policies and policy making; • analyse the conceptual characteristics, policy coherence and international embedment of EU environmental policies; • encourage students to assess the quality of EU environmental and Climate

	Action Policies in view of their overall coherence; • pay particular tribute to EU Climate Action and the 2015 COP- 21 Climate Negotiations in Paris; • provide students with an opportunity to explore areas of special interest through their individual research papers; • further develop students' research and writing skills via their papers. • During the seminar students will: • acquire knowledge on EU environmental and Climate Action policies; • gain a general overview and understanding of environmental policy - making; • understand basic policy analysis practices and techniques and apply them in a simulation game; • acquire academic presentation competences and negotiation experience; • practice free presentation and argumentation; • improve language skills through active communication in English. b) • To provide students with applications context for the various elements of environmental science addressed in other courses within the IMES curriculum. • To assist students in understanding how international and national policies on environmental issues are developed and implemented. • To provide students with understanding of how the private sector, inter-governmental and non-governmental organizations recognize and address their environmental obligations • To enable students to recognize the important elements of an organization's environmental performance and to understand how such performance is measured, improved, and reported to stakeholders
3	**Contents:** a) Environmental issues and stresses are among the most pressing challenges of our times. As concerns over degradation of ecosystems, pollution, loss of biodiversity, climate change or extreme weather events have spread, environmental policies turned central stage at global and European level. Environmental policies have yet long played a less prominent role within EU policy - making and it was only with the Single European Act of 1987 that the policy area was based on EU primary law. Before that period, environmental policies were decided based on single market related competences and treaty foundations, leading to an uncoordinated policy approach and a strong economic rationale. In present times, Environmental policies have become most complex subjects of supranational policy - making and international negotiations. Analysed through a sustainability lens, ecological, economic, Social - political, geo-political and development concerns are interlinked in this area. Globally, ideological disputes about resource dependency, environmental and social justice as well as global North - South relations frame the debate and influence EU environmental policy paradigms and approaches, especially in the field of EU Climate Action. Against this background, the course will analyse the EU's particular approaches to wards different environmental policies focusing on their conceptual characteristics, policy

	coherence and international embedment. It will analyse main EU environmental policies and measures as well as their overall conceptual approach. Moreover, the seminar will particularly examine the EU's role in international climate change negotiations in for a post - Kyoto legal framework. In doing so, the course takes into consideration two particular perspectives: In a cross - temporal one, it analyses the policy area's development over time. This perspective includes the analysis of European environmental policies of different temporal origin. In a cross - sectoral dimension, the seminar analyses the EU's environmental policies approach in terms of policy coherence between different policies and beyond by paying tribute to so - called 'mainstreaming aspects'. b) This course will examine the interplay between institutions, actors, and the environment. Although including the local and regional scales, our primary focus lies at the global level, where sets of rules, actions and processes constitute what is usually referred to as "Global Environmental Governance". The stress will be on the aspect of change, such as with climate change, desertification, or loss of biodiversity, and how political systems, corporate actors as well as the public drive, are impacted upon and respond to environmental change. The course will take an inter-disciplinary approach and operate at the interface between basic and applied science. Case studies and narratives will be examined.
4	**Type of Course:** Lecture, Seminar
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the combined examination will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Paper and/or presentation. Subject of examination: the contents of the lectures during the winter and summer term of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:**

	5% (6 LP)
10	**Person in Charge:** a) Dr. Umbach: Wirtschafts- und Sozialwissenschaftliche Fakultät b) Dr. Alexander Follmann: Geographisches Institut der Universität zu Köln
11	**Other Information** None

Basic Module: Environmental Management

Code Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-B-Ma	90 h	3	1. and 2. Sem.	WiSe	1 Semester

1	**Title and Term:** a) Environmental Policy and Management (WiSe)	**Contact Time:** 2 SWS / 30 h	**Self-study:** 60 h	**Size:** 30

2 **Goals of Qualification:**

a)

- To provide students with applications context for the various elements of environmental science addressed in other courses within the IMES curriculum.
- To assist students in understanding how international and national policies on environmental issues are developed and implemented.
- To provide students with understanding of how the private sector, inter-governmental and non-governmental organizations recognize and address their environmental obligations
- To enable students to recognize the important elements of an organization's environmental performance and to understand how such performance is measured, improved, and reported to stakeholders

3	**Contents:** a) This course will examine various aspects of environmental policy and management, primarily in the U.S. It is intended to provide the IMES students with application context for much of the science covered in the IMES curriculum. The course will have both classroom and online components using Duquesne University's Blackboard® course management system. We will examine how a national environmental policy develops and various means of implementation. We will than address the environmental aspects of organizations and how those aspects dictate the driving forces for organizational activities dealing with human health and the environment.
4	**Type of Course:** Lecture, Seminar
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the combined examination will be announced at the start of each course by the professors in charge. The enrollment for the examination will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Two of the following tasks must be completed: Written, oral or practical exam; or a combination. Subject of examination: the contents of the lectures during the winter and summer term of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 2,5% (3 LP)
10	**Person in Charge:** a) Edward C. Moretti - Bayer School of Natural and Environmental Sciences - Duquesne University in Pittsburgh, Pennsylvania, USA.

11	**Other Information** None

Basic Module: Sociology					
Code Number: Tba	**Workload:** 90 h	**Credit Points:** 3	**Term:** 1. Sem.	**Frequency:** WiSe/SoSe	**Duration:** 1 Semester
1	**Title:** a) Environmental Sociology: Basic Approaches and Research Results		**Contact Time:** 2 SWS/30 h	**Self-study:** 60 h	**Size:** 30
2	**Goals of Qualification:** a) • To get an overview on the topics, theoretical approaches and empirical findings of Environmental Sociology • To demonstrate, how environmental sociology is linked to general theories of Sociology • To exemplify how empirical studies on environmental problems are to be designed, conducted and analysed • To obtain an overview of the culture-specific attitudes as well as the use of different environments (deserts, rain forest, arctic etc.) of the different populations.				
3	**Contents:** a) In the first part, a brief introduction to sociological reasoning will be given, followed by some examples of environmental problems. For these examples, the sociological approach will be demonstrated. The second part pertains to two theories used in environmental sociology: Rational Choice Theory and the Theory of Collective Goods (or common pool resources). We than move to complex decision structures under uncertainty. The next part is devoted to empirical studies of the relationship of environmental knowledge, environmental concern and environmental behavior, followed by a series of studies on the conditions of pro-environmental behavior. All sessions will be introduced by an overview of the topic suggested literature. The session will then be devoted to the discussion of mainly two major texts for the topic under study. Students are expected to have read these two texts in advance.				

4	**Type of Course:** Lecture, Seminar
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Paper and presentation. Subject of examination: the contents of the lectures (a and b) of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the grading in the final grade** 2,5% (3 LP)
10	**Person in Charge:** a) Prof. Dr. Jürgen Friedrichs, Universität zu Köln - Forschungsinstitut für Soziologie
11	**Other Information** None

<table>
<tr><td colspan="7">Basic Module: Anthropology</td></tr>
<tr><td colspan="2">Code Number:

MA-IMES-B-Anth</td><td>Workload:

180 h</td><td>Credit Points:

6</td><td>Term:

1. and 2. Sem.</td><td>Frequency:

WiSe/SoSe</td><td>Duration:

2 Semester</td></tr>
<tr><td>1</td><td colspan="3">Title:

a) Introduction to Human and Env. Relations

b) Basic Concepts of Research in Hazard, Vulnerability, Risk and Risk Management</td><td>Contact Time:

2 SWS/30 h

2 SWS/30 h</td><td>Self-study:

60 h

60 h</td><td>Size:

30

30</td></tr>
<tr><td>2</td><td colspan="6">Goals of Qualification:

a)

• To get an overview over recent approaches to the relationship between humans and their natural environment from a cultural studies perspective

• To exemplify the interconnectedness between nature and culture

• To demonstrate how cultural studies can complement and enrich environmental sciences and how the natural and social sciences interact</td></tr>
<tr><td>3</td><td colspan="6">Contents:

a) The aim of this lecture is to show the extent to which current Western views of the African environment, and views on the role of “traditional” society in its preservation or change, have been shaped by an uncritical adaptation of earlier approaches (from the 19th and 20th century). The lecture deals with early evolutionist and diffusionist thinking as well as with the emergence of colonial tropical sciences which altogether created an epistemological basis for the analysis of man-environment relations in Africa in the latter part of the 19th and early part of the 20th century. Moreover, the impact of globalization and the emergence of large international organisations (such as the UNEP or UNICEF) on human-environment research in Africa will be assessed.

b) The seminar aims at introducing and explaining the key concepts (hazard, vulnerability, risk, risk management) and at discussing their role in science as well as in the humanities when looking at man-environment-dynamics. Students shall be introduced to concepts and research traditions in a concentrated manner, in order to understand the viewpoint of each discipline on the respective concepts. Taking examples from rural and urban populations and from a wide variety of socio-economic situations students will learn how to assess vulnerability and resilience.</td></tr>
</table>

	They will be introduced to the manifold ways in which people attempt to manage risks and will learn to understand that these individually rational approaches to risk do not always result in sustainability and development at the community level.
4	**Type of Course:** Lecture, Seminar
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: (combined examination) Written paper and oral presentation. Subject of examination: the contents of the lectures (a and b) of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the grading in the final grade** 5% (6 LP)
10	**Person in Charge:** a) N.N., Institute of Ethnology – University of Cologne
11	**Other Information** None

Basic Module: Education					
Code Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-B-Edu	180 h	6	1. and 2. Sem.	WiSe/SoSe	2 Semester

1	**Title and Term:**	**Contact Time:**	**Self-study:**	**Size:**
	a) Basic aspects of environmental education (WiSe)	2 SWS / 30 h	60 h	30
	b) Didactics of excursions (SoSe)	2 SWS / 30 h	60 h	30

2 Goals of Qualification:

a) and b) The students get an overview of theory and practical aspects of environmental education. Interdisciplinary cooperation of natural sciences is strongly emphasised (for example: biology and chemistry work together for water research, geography and biology: climate change and vegetation). At the end of winter term: Examination. Participants are prepared to organize excursions. At the end of summer term: Excursion-reports and planning an own excursion.

3 Contents:

a) b) The module consists of two parts: A theoretical introduction (Winter-term) and a practical part dealing mainly with didactics of excursions (Summer-term).

a) Basic aspects of environmental education (Winter-term): Basic aspects of education, basic aspects of environmental education with special emphasis on botany, zoology, ecology and geography. Environmental issues and the public. Environmental experiments in biology and physics – much more interesting as the pure theory! Project-teaching. Team-teaching.

b) Didactics of excursions (Summer-term): Theoretical introduction, participation in at least two excursions (Environmental themes), planning and organizing of one full-day excursion for students from the Faculty of Mathematics and Natural Sciences. Evaluation report.

4 Type of Course:

Lecture, Seminar

5 Status of the Module in the Program:

Compulsory Module Choice

6 Requirements for Participation:

None

7	**Type of Examination:** The dates of the exam will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Combined examination: Presentation and a written protocol. Subject of examination: the contents of the lectures of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 5% (6 LP)
10	**Person in Charge:** a) Prof. Dr. Hans Georg Edelmann, Seminar für Biologie und ihre Didaktik
11	**Other Information:** None

Basic Module: Geographic Information Systems					
Coad Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-B-GIS	90 h	3	2. Sem.	SoSe	2 Semester
1	**Title:**		**Contact Time:**	**Self-study:**	**Size:**
	a) Spatial Environmental Methods		2 SWS / 30 h	60 h	30
2	**Goals of Qualification:** a) Understanding of the principles of spatial data concepts, handling, analysis and presentation.				

3	**Contents:** a) In this lecture, the IMES students get an introduction to the basic concepts and methods of spatial data handling, management, analysis, and presentation by using GIS. The lecture bases on the Virtual Campus Course “Introduction into ArcGIS, Part I” provided by ESRI. So, the students also learn how to use the GIS-Software ArcGIS and how to handle ESRI‟s spatial data formats like shape files, coverages, geodatabases, and grids.
4	**Type of Course:** Lecture, Seminar, Computer Laboratory
5	**Status of the Module in the Program:** Compulsory Module in the IMES-Program
6	**Requirements for Participation** None
7	**Type of Examination:** The dates of the examination will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Combined examination: Computer based GIS project and exam. Subject of examination: the contents of the lectures of this module description. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 2,5% (3 LP)
10	**Person in Charge:** a) Prof. Dr. Georg Bareth, Universität zu Köln - Geographisches Institut
11	**Other Information** None

<table>
<tr><td colspan="7">Basic Module: Introduction to Environmental Statistics</td></tr>
<tr><td colspan="2">Coad Number:
MA-IMES-B-Intro-Sta</td><td>Workload:
90 h</td><td>Credit Points:
2</td><td>Term:
1. Sem.</td><td>Frequency:
WiSe</td><td>Duration:
1 Semester</td></tr>
<tr><td>1</td><td colspan="3">Title:
a) Statistics</td><td>Contact Time:
2 SWS / 30 h</td><td>Self-study:
60 h</td><td>Size:
30</td></tr>
<tr><td>2</td><td colspan="6">Goals of Qualification:
Students shall have an understanding of basic statistic methods. (Descriptive and probability statistics)</td></tr>
<tr><td>3</td><td colspan="6">Contents:
a) Students shall get a basic understanding of statistical methods which are relevant for the scientific work in the field of environmental sciences.</td></tr>
<tr><td>4</td><td colspan="6">Type of Course:
Lecture and Computer based work</td></tr>
<tr><td>5</td><td colspan="6">Status of the Module in the Program:
Compulsary Module in the IMES-Program</td></tr>
<tr><td>6</td><td colspan="6">Requirements for Participation:
None</td></tr>
<tr><td>7</td><td colspan="6">Type of Examination:
The dates of the written examination will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination.
Type of examination: Exam. Subject of examination: the contents of the lectures of this module description
If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.</td></tr>
<tr><td>8</td><td colspan="6">Requirements for Allocation of Credit Points:</td></tr>
</table>

	Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 2,5 % (3 LP)
10	**Person in Charge:** a) Dr. Reamer – Institute of Geography, University of Cologne
11	**Other Information:** None:

Basic Module: Introduction to Environmental Chemistry					
Coad Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-B-Intro-Che	90 h	2	1. Sem.	WiSe	1 Semester
1	**Title:** a) Chemistry		**Contact Time:** 2 SWS / 30 h	**Self-study:** 60 h	**Size:** 30
2	**Goals of Qualification:** a) Students shall get a basic understanding of chemistry which are relevant for the scientific work in the field of environmental sciences.				
3	**Contents:** The first part of the lecture deals with some of the basic concepts of general chemistry, namely the composition and properties of matter and the changes it undergoes. The emphasis is on an understanding of reaction yield, energy balance of chemical reactions, reaction kinetics, chemical equilibrium, redox & acid-base reactions as well as organic chemistry. In the second part of the lecture these concepts are then applied to understand one major aspect of environmental chemistry, the global material cycles. Examples discussed are the cycles of water, carbon, nutrients, rocks & pollutants.				
4	**Type of Course:** Lecture				

5	**Status of the Module in the Program:** Compulsary Module in the IMES-Program
6	**Requirements for Participation:** None
7	**Type of Examination:** The dates of the written examination will be announced at the start of each course by the professors in charge. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally; therefore the person in charge of the module can choose other types of examination. Type of examination: Exam. Subject of examination: the contents of the lectures of this module description If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 2,5 % (3 LP)
10	**Person in Charge:** Prof. Dr. Stephan Schmitz, Wissenschaftliche Standortleitung. Fachhochschule des Mittelstandes (FHM) Tec Rheinland
11	**Other Information:** None:

Supplementary Work Shops: a) Soft Skills b) Science Communication					
Coad Number: Tba	**Workload:**	**Credit Points:**	**Term:** 1-4 Sem.	**Frequency:** WiSe/SoSe	**Duration:** 1-4 Semester
1	**Title** a) Intercultural training b) Presentation and writing skills		**Contact Time**	**Self-study**	**Size** **30**

2	**Goals of qualification:** a) The courses have the goal to improve the ability of students to present complex topics and to create presentations in an adequate way. If necessary, intercultural training will be offered to the students. b) The scientific writing skills of students will be improved.
3	**Contents:**
4	**Type of Course** Lecture, Seminar
5	**Status of the Module in the Program:** Compulsory additionally offered workshops
6	**Requirements for Participation** None
7	**Type of Examination:** Active Participation
8	**Requirements for allocation of credit points:** No credits will be allocated
9	**Significance of the grading in the final grade** -
10	**Person in Charge:** Prof. Dr. Kirk Junker, Universität zu Köln – Lehrstuhl für US-amerikanisches Recht
11	**Other Information** Workshops may be offered through collaboration partner, M.Sc. Science Communication Program, Dublin City University.

2.2 Advanced Modules

Integrated Advanced Module in Environmental Sciences					
Coad Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-A-GIS	180 h	6	3. Sem.	WiSe	1 Semester
1	**Courses**		**Contact Time**	**Self-study**	**Size**

	a) tba	60	120	30
2	**Goals of Qualification:** Based on the knowledge of the first two terms, students shall analyses concrete problems from a social and natural science perspective. Therefore, the course will be a synthesis of natural and social sciences and highlight interlink ages between the different fields. Students will be taught by professors who have a natural and social science background.			
3	**Contents:** The course will cover concrete environmental problems of our time. Students will be asked to analyze a problem based on a literature review and propose solutions.			
4	**Type of Course:** Seminar			
5	**Status of the Module in the Program:** Mandatory Module in the IMES-Program			
6	**Requirements for Participation:** Finalizing the first two terms with the required 60 credit points.			
7	**Type of Examination:** Requirements for participation in the exam: active and continuous participation throughout the semester The dates of the exam of each course (according to topic 1 of this module description) will be announced at the start of each course. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally, therefore the person in charge of the module can choose other types of examination. Examiners: Teachers of the module. Type of examination: Written, oral or practical exam; or a combination. Subject of examination: the contents of the lectures description. Grading of the module: the grading of the module is calculated as the arithmetic mean of the courses which are assigned to this module. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.			
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been			

	successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 5% (6 LP)
10	**Person in Charge:** a) tba
11	**Other Information** None

Advanced Module: Atmosphere					
Coad Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency:**	**Duration:**
MA-IMES-A-At1	360 h	12	3. Sem.	WiSe	1 Semester
1	**Courses** a) Basics of topics 1 – 4 (s. Contents) b) Precipitation analysis c) Weather briefing (weather analysis and forecasting) d) Impact analysis		**Contact Time** 120	**Self-study** 240	**Size** 30
2	**Goals of Qualification:** • Experience special meteorological measurement techniques • Learn about available meteorological data sets • Learn about data analyses methods in meteorology • Learn about presentation techniques in meteorology Writing skills and reviewing of scientific papers • Preparation for thesis writing				
3	**Contents:** Topics: Within the module, *one* of the following topics can be chosen: 1. Analysis and prediction of wind energy potential. 2. Calculation methods for air pollution on different scales – including transport and transformation processes. 3. Impacts of meteorological extreme events, like heavy precipitation (including floods), extreme winds and heat waves. 4. Consequences and possible impacts of climatic change. Tools: Within the modules, different basics are introduced, which are necessary				

	to work within the above mentioned topics during later stages. These cover for example: • Special methods of measurement (e.g. precipitation networks, evaporation) • Available meteorological data on different scales • Data analyses of observational and simulated data • Presentation of data with the aid of Geographical Information Systems • Simulation tools (diagnostic and prognostic) for different atmospheric phenomena Multidisciplinary: Special emphasis is put on application oriented work, on meteorological impacts and on the links to other disciplines, e.g. to hydrology, biosphere, medicine, economy and spatial environmental methods. Structure of the modules: The expenditure of time for each module corresponds to six weeks and can be arranged at any time during the semester. The modules consist mainly of non-tutored courses with problem oriented self paced learning. One day of the week (suggestion: preferably Friday) tutored sessions will be given, mainly to cover multidisciplinary aspects; these tutored sessions are also part of other modules (e.g. of hydrology). Weekly weather briefings during that day will ensure application oriented aspects. Within the module, the students will take part in a Scientific Writing program and a project management training course.
4	**Type of Course:** a, c, d) Seminar/Practical; b) Lecture/Seminar
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** Successful participation in the basic module Atmosphere
7	**Type of Examination:** Requirements for participation in the exam: active and continuous participation throughout the semester The dates of the exam of each course (according to topic 1 of this module description) will be announced at the start of each course. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally, here fore the person in charge of the module can choose other types of examination. Examiners: Teachers of the module. Type of examination: a) Written Exam. Subject of examination: the contents of the lectures description. Grading of the module: the grading of the module is calculated as the arithmetic mean of the courses which are assigned to this module.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been

	successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 10% (12 LP)
10	**Person in Charge:** a) Prof. Dr. Yaping Shao, Universität zu Köln - Institut für Geophysik und Meteorologie
11	**Other Information** None

Advanced Module: Biosphere					
Coad Number: MA-IMES-A-Bio	**Workload:** 360 h	**Credit Points:** 12	**Term:** 3. Sem.	**Frequency:** WiSe	**Duration:** 1 Semester
1	**Courses** a) Applied issues of Aquatic and Microbial Ecology b) Interactions between Eukaryotic Microorganisms		**Contact Time:** 120	**Self-study:** 240	**Size:** 6
2	**Goals of Qualification:** • learn basic techniques of ecology and bio-environmental technology • understand the role of organisms in the functioning of ecosystems • learn to address environmental problems using biological thinking • learn to use scientific literature and present results in written and oral form • prepare for Master-Thesis				
3	**Contents:** The module Biosphere consists of hands-on practical in basic and applied ecology and in bio- environmental technology of aquatic and terrestrial ecosystems including microorganisms (bacteria and algae), plants and animals. These practical (laboratory and field work) are accompanied by lectures addressing the theoretical framework of the practical and a seminar during which each student will present a lecture (20 min) about a current topic based on original scientific publications/scientific reviews published in recent years. Students will work in groups of two/three in the practical, which are problem-oriented. A protocol taking the form of a short scientific paper (Introduction,				

	Methods, Results, Discussion, References) will be prepared by each student (about 20 pages) and handed in for grading. The following aspects will predominantly be addressed during the course: • Applied Issues of Aquatic and Microbial Ecology (selected topics such as limnology of lakes and rivers, drinking water reservoirs, Cologne water works and drinking water supply, wastewater treatment, water quality monitoring, , nature conservation, fish ecology, Ecological Rhine station of the University, Ecological Field Station in the inundation area of the Lower Rhine) • Interactions between Eukaryotic Microorganisms – Competition and Consumption (Laboratory microcosms will be used to manipulate the supply of resources (nutrients, light) and the presence of consumers (ciliates, rotifers) and to measure the response of microalgae assemblages. Goals are to handle aquatic microorganism, and to understand the fundamental role of biotic interactions for the structure of ecological communities. The module will be offered during the first 6 weeks of the semester in a compact form. The course includes a one week field study (October 18- October 22, 2004) at the Ecological Field Station of the Zoological Institute in Rees-Grietherbusch, Lower Rhine Valley. Within the module, the students will take part in a Scientific Writing program and a project management training course.
4	**Type of Course:** Seminar, Lecture and Internship
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** Successful participation in the basic module Biosphere
7	**Type of Examination:** Requirements for participation in the exam: active and continuous participation throughout the semester The dates of the exam of each course will be announced at the start of each course. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally, here fore the person in charge of the module can choose other types of examination. Examiners: Teachers of the module. Type of examination: scientific protocol (60%), oral presentation (40%). Subject of examination: the contents of the lectures according to topic 5 of this module description Grading of the module: the grading of the module is calculated as the arithmetic mean of the courses which are assigned to this module.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been

	successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade** 10% (12 LP)
10	**Person in Charge:** a) Prof. Dr. Arndt, Universität zu Köln - Zoologisches Institut b) Prof. Dr. Hillebrand, Universität zu Köln - Botanisches Institut
11	**Other Information:** None

Advanced Module: Geosphere					
Coad Number MA-IMES-A-Geo	**Workload:** 360 h	**Credit Points:** 12	**Term:** 3. Sem.	**Frequency:** WiSe	**Duration:** 1 Semester
1	**Courses:** a) Geophysics		**Contact Time:** 120	**Self-study:** 240	**Size:** 10
2	**Goals of Qualification:** • Learn about geophysical measurement techniques • Learn about geophysical modeling • Learn about geological interpretation of geophysical data • Scientific talk and writing a scientific report				
3	**Contents:** The main aim of this block course is to demonstrate and to show the practical applications of the geophysical techniques. In a team based approach small student groups will give scientific lectures, carry out own measurements, analyze, and discuss their own data. Finally, they will interpret their data by using the geophysical modeling software. One day per week (probably Friday) tutored sections will be given. The tutor will give no lecture, but he will act as a moderator in the seminar. He will introduce the students to the geophysical devices, the geophysical measuring techniques and the geophysical modeling software. The tutor will also be in the field during the field measurements of the students. After this introduction the student group will be able to do its own research. The following time schedule is suggested for the course: **Week 1:** Presentation of the literature of the module, guidelines of the module, rules of presenting a scientific talk and of writing a scientific report.				

	Week 3: Direct current resistivity method: -lecture by the students about the principles, the data interpretation, related interdisciplinary case histories, and about the demonstration of the geophysical device -Discussion about the lecture -Geophysical field measurements close to Cologne -Interpretation of data using the modeling software during the next two weeks **Week 5:** Magnetic methods -the same time schedule and structure as week 3- **Week 7.** Georadar technique -the same time schedule and structure as week 3- **Week 9:** Seismic methods -the same time schedule and structure as week 3- **Week 11:** Radiomagnetotellurics -the same time schedule and structure as week 3- Within the module, the students will take part in a Scientific Writing program and a project management training course.
4	**Type of Course:** Seminar and Internship
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** Successful participation in the basic module Atmosphere
7	**Type of Examination:** Requirements for participation in the exam: active and continuous participation throughout the semester The dates of the exam of each course will be announced at the start of each course. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally, here fore the person in charge of the module can choose other types of examination. Examiners: Teachers of the module. Type of examination: scientific protocol and presentation Subject of examination: the contents of the lectures description Grading of the module: the grading of the module is calculated as the weighted mean of the courses which are assigned to this module.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 10% (12 LP)

10	**Person in Charge:** a) Prof. Dr. Bülent Tezkan, Universität zu Köln - Institut für Geophysik und Meteorologie
11	**Other Information:** None

Advanced Module: Hydrosphere					
Coad Number:	**Workload:**	**Credit Points:**	**Term:**	**Frequency**	**Duration:**
MA-IMES-A-Hydro	360 h	12	3. Sem.	WiSe	1 Semester
1	**Courses:** a) Seminar: Topics of Hydrology and Water Resources Management b) Practical: Methods in Physical Hydrology c) Research seminar		**Contact Time:** a) 2 SWS/30 h b) 4 SWS/60 h c) 2 SWS/30 h	**Self-study:** a) 60 h b) 120 h c) 60 h	**Size:** 10
2	**Goals of Qualification:** The students gain: • the competence to independently work out the state of the art of research on a specific topic of hydrology or water resources management; • the competence to evaluate and scientific results from literature; • the competence to design and compose own scientific papers; • the competence to present research results on a specific topic of hydrology or water resources management in an oral presentation and in a written paper; • apply field-based or computer-based methods for problem solving in hydrology or water resources management; • define and organize a research project against the background of a given task in hydrology or water resources management; • develop a time schedule, identify the appropriate research methods and approaches, provide the required data either by measurement or from available other sources; • analyse and present their results as a written report.				

3	**Contents:** a) Seminar: Topics of Hydrology Students learn to know the state of the art of research of specific topics of hydrology or water resources management by means of scientific literature on the specific topic. By independently developing and performing an oral presentation and a scientific paper as well as discussing the works of the other participants, the students learn about state of the knowledge as well as methodological knowledge of scientific working. The different topics prepared by the students will provide an overview on the state of the art of research of hydrology or water resources management. The intensive work on scientific literature is preliminary. b) Practical: Methods of Physical Hydrology The practical combines aspects of problem analysis, organisation of own work, specific methodological approaches in hydrology, as well as methods of data analysis. The course prepares students to independently work on scientific hydrological problems. The methods can either be field-based methods (e.g. measurement techniques of water fluxes) or computer based methods (e.g. hydrological Modelling, GIS and remote sensing approaches). c) Research seminar: This seminar aims at students planning to write their master's thesis in Hydrology. This seminar serves as a discussion forum for the research done in the course of the master's thesis.
4	**Type of Course:** Seminar, Practical
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** Successful participation in the basic module Geosphere II
7	**Type of Examination:** Requirements for participation in the exam: active and continuous participation throughout the semester. Examiners: Teachers of the module. Type of examination: term paper (50%), oral presentation (25%), protocol of the practical work (25%). Subject of examination: the contents of the lectures description Grading of the module: the grading of the module is calculated as the weighted mean of the courses which are assigned to this module.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).

9	**Significance of the Grading in the Final Grade** 10% (12 LP)
10	**Person in Charge:** a) Prof. Dr. Karl Schneider, Geographisches Institut
11	**Other Information** None

Advanced Module: Environmental Law					
Coad Number: MA-IMES-A-Law	**Workload:** 360 h	**Credit Points:** 12	**Term:** 3. Sem.	**Frequency:** WiSe	**Duration:** 1 Semester
1	**Courses:** a) Biodiversity Law b) Law Field Work b) European Environmental Law c) Law of Climate Change d) Transboundary Water Conflict		**Contact Time:** 120	**Self-study:** 240	**Size:** 3
2	**Goals of Qualification:** • Learn basic legal research techniques for primary sources of law. • Learn to analyse secondary literature against the primary sources of law. • Learn to incorporate law into social science field work methods. • Learn to incorporate law into natural science field work methods. • Learn the borders between law and other areas of social science in practice.				
3	**Contents:** Content will vary according to the course on offer that particular semester. The course variation depends upon available faculty and travel opportunities for researchers. The student will research and develop a thesis in environmental law, with specific reference to the interplay of international environmental law and domestic environmental law, through a case study on a topic such as the riparian rights of various countries to transboundary waters such as the Rhein, Colorado, Tigris or Nile Rivers, transboundary, climate change, or the management of plant or animal species through conservation, forestry, nature reserves, and other legal mechanism. The students must be able to find primary sources of law and assess secondary literature that discusses the primary sources of law. Field work in the national parks of India is optional.				

4	**Type of Course:** Lecture, field work and combinations of the two.
5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** Students must have completed both courses in the basic Environmental Law module. Students who select a course with a field work component are required to participate in all classroom and lecture components at the field site before, during and after entering the national park or nature reserve.
7	**Type of Exam:** Requirements for the participation in the examination are active and continuous participation throughout the semester. The dates of the exam of each course (according to topic 1 of this module description) will be announced at the start of each course. The enrollment for the exam will be enrollment in the course on the first day of semester. Re-examinations will be available according to the IMES study regulations. Examiners: Teachers of the module. Type of examination: Students will submit an original and independent research report during the examination period at the end of the semester. The specifics will be determined by the course offered, as follows: a) scientific protocol (40%), oral presentation (20%), documented bibliography (40%). b) If field work is included, it shall constitute half of the scientific protocol from (a), and an oral presentation in the field for all 20% of (a).Subject of examination: the contents of the lectures description. c) d) and e) will be examined by an original and independent research report during the examination period at the end of the semester. The specifics will be determined by the course offered. Grading of the module: the grading of the module is calculated as the weighted mean of the courses which are assigned to this module. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 10% (12 LP)
10	**Person in Charge:**

	a) Prof. Dr. Kirk Junker, Universität zu Köln – Department of Us-american law b) Prof. Dr. Shamita Kumar, Bharati Vidyapeeth University, Pune, India.
11	**Other Information:** None

Advanced Module: Environmental Policy and Management					
Coad Number: MA-IMES-A-Ma	**Workload:** 360 h	**Credit Points:** 12	**Term:** 3. Sem.	**Frequency:** WiSe	**Duration:** 1 Semester
1	**Courses:** a) Environmental Policy and Management		**Contact Time:** 120	**Self-study:** 240	**Size:** 6
2	**Goals of Qualification:** Students will achieve: 1. An understanding of various environmental management systems and instruments and how they can be applied in different management situations, 2. How the environmental aspects of an organization can create business risks and how those risks are assessed and managed, 3. An understanding of corporate decision making taking environmental, social, and economic aspects into consideration, 4. How environmental management fits into the context of sustainability management.				
3	**Contents:** This module concentrates on environmental and sustainability management systems and instruments. The students shall define their own projects in this research field and work on the relevant contents by doing a comprehensive literature research as well as writing a research paper. If the students don't have a specific topic yet, case studies and/or projects will be provided by the lecturer.				
4	**Type of Course** Lecture, Seminar				
5	**Status of the Module in the Program:**				

	Compulsory Module Choice
6	**Requirements for Participation:** Successful participation in the basic module Environmental Policy and Management
7	**Type of Exam:** Requirements for participation in the exam: active and continuous participation throughout the semester The dates of the exam of each course (according to topic 1 of this module description) will be announced at the start of each course. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally, therefore the person in charge of the module can choose other types of examination. Examiners: Teachers of the module. Type of examination: paper (60%), report (40%). Subject of examination: the contents of the lectures description Grading of the module: the grading of the module is calculated as the weighted mean of the courses which are assigned to this module.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 10% (12 LP)
10	**Person in Charge:** a) a) Edward C. Moretti - Bayer School of Natural and Environmental Sciences - Duquesne University in Pittsburgh, Pennsylvania, USA.
11	**Other Information:** None

<table>
<tr><td colspan="7">Advanced Module: Political Ecology & Environmental Governance</td></tr>
<tr><td colspan="2">Coad Number:
MA-IMES-A-Pol</td><td>Workload:
360 h</td><td>Credit Points:
12</td><td>Term:
3. Sem.</td><td>Frequency:
WiSe</td><td>Duration:
1 Semester</td></tr>
<tr><td>1</td><td colspan="3">Courses:
Collective class sessions (contents A and B) and individual supervision (content C).</td><td>Contact Time:
120</td><td>Self-study:
240</td><td>Size:
6</td></tr>
<tr><td>2</td><td colspan="6">Goals of Qualification:
The advanced module will deepen insights and knowledge acquired from the basic modules of Political Ecology & Environmental Governance I & II and provide advanced and in-depth knowledge in two specific areas. In addition, know-how and best practice examples of how to conceptualize and successfully write a thesis using social science perspectives and methods will be discussed. Individual research topics and “mini-projects” will be identified, developed and peer-reviewed, and the authoring of term papers will be supervised.</td></tr>
<tr><td>3</td><td colspan="6">Contents:
A. Methods used in social sciences. Know-how and best practice examples of how to conceptualize and successfully write a thesis.
B. In-depth thematic areas:
1. Modes of global environmental governance: 1.1. New and emerging actors and their influence and power; 1.2. Legitimacy and accountability in global environmental governance; 1.3. New fora and networks.
2. Resilience of coupled socio-ecological systems: 2.1. Marine ecosystems; 2.2. Urban systems.
C. Development and review of individual research topics.</td></tr>
<tr><td>4</td><td colspan="6">Type of Course
Lecture, Seminar</td></tr>
<tr><td>5</td><td colspan="6">Status of the Module in the Program:
Compulsory Module Choice</td></tr>
<tr><td>6</td><td colspan="6">Requirements for Participation:
Successful participation in the basic module Environmental Politics</td></tr>
<tr><td>7</td><td colspan="6">Type of Exam:
Requirements for participation in the exam: active and continuous participation throughout the semester
The dates of the exam of each course (according to topic 1 of this module description) will be announced at the start of each course. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally, therefore the person in charge of the module can choose other types of examination.</td></tr>
</table>

	Examiners: Teachers of the module. Type of examination: project work (60%), presentation/report (40%). Subject of examination: the contents of the lectures description Grading of the module: the grading of the module is calculated as the weighted mean of the courses which are assigned to this module. If both, the professor in charge and the students, agree on another as the above mentioned examination, other assessments, which must be consistent with the study regulation, can be conducted.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the Final Grade:** 10% (12 LP)
10	**Person in Charge:** a) Matthias Garschagen, Associate Academic Officer, United Nations University
11	**Other Information:** None

Advanced Module: Environmental Spatial Methods					
Coad Number: MA-IMES-A-GIS	**Workload:** 360 h	**Credit Points:** 12	**Term:** 3. Sem.	**Frequency:** WiSe	**Duration:** 1 Semester
1	**Courses:** a) GIS application in soil science b) GIS application in hydrology c) GIS applications in urban planning		**Contact Time:** 120	**Self-study:** 240	**Size:** 10
2	**Goals of Qualification:** • Application of GIS in environmental and urban studies • Learning about data sources, special processing techniques and integration of GIS and spatial models • Report writing techniques				

3	**Contents:** This module will cover aspects of GIS use and data analysis in social as well as natural sciences. The module will cover three sections: Urban studies, soil sciences and hydrology. A focus of this course will be on learning advanced data analysis techniques in these different disciplines. Building upon the basic GIS techniques learned in in introductory course, this course will focus on providing information for decision makers and planners. The main workload of the module is occupied by self paced, problem based learning. A general problem statement will be used to identify a scientific research task. This research task will be addressed based upon suitable literature, textbooks and internet resources. The teaching staff assumes the role of a tutor, moderating the course rather than providing lectures. The urban studies section will cover the following issues under the general heading of “Spatial social segregation in global cities – Examplified by London: 1. Introduction to the research issues: Readings of the relevant literature regarding „Global Cities“ (esp. GaWC-Group, Friedman, Sassen); Identification and elaboration of the scientific problem. 2. Formulation of a research hypothesis 3. Development and justification of an solution approach to quantify segregation; Choice of suitable variables / parameters as well as spatial reference systems. 4. Data acquisition (Geometry, Attributes), Generation of a GIS, applying / developing suitable scripts 5. Conduction and analysis of research 6. Presentation of results (tables, graphs, maps) 7. Interpretation of results and comparison with literature. The hydrology section will cover the use of GIS for flood modeling and prediction. The following aspects are covered: 1. Processing techniques of digital elevation data are investigated (Delineation od watersheds and streams), 2. hydrologic data base (land use, soils, DEM) 3. modeling soil water balance with GIS 4. modeling surface water balance (ET, Runoff) The soil science section will cover the use of GIS for capturing, editing, analyzing and visualizing spatial soil data. The following aspects are covered: 1. Why are spatial soil data important? 2. Vector versus raster data models for soil analysis 3. Availability of soil data 4. Relief analysis 5. Disaggregation of existing soil maps 6. GIS-based soil mapping Within the module, the students will take part in a Scientific Writing program and a project management training course.
4	**Type of Course:** Tutorial and Internship

5	**Status of the Module in the Program:** Compulsory Module Choice
6	**Requirements for Participation:** Successful participation in the basic module Environmental Spatial Methods
7	**Type of Exam:** Requirements for participation in the exam: active and continuous participation throughout the semester The dates of the exam of each course (according to topic 1 of this module description) will be announced at the start of each course. The enrollment for the exam will be simultaneous with the start of the exam. Re-examinations will also be announced orally, here fore the person in charge of the module can choose other types of examination. Examiners: Teachers of the module. Type of examination: two short (25% each) and a long (50%) paper. Subject of examination: the contents of the lectures description. Grading of the module: the grading of the module is calculated as the weighted mean of the courses which are assigned to this module.
8	**Requirements for Allocation of Credit Points:** Credit points are allocated when examinations of the module parts have been successfully completed with the minimum grade sufficient (4.0).
9	**Significance of the Grading in the final Grade:** 10% (12 LP)
10	**Person in Charge:** a) Prof. Dr. Georg Bareth, Universität zu Köln – Geographisches Institut
11	**Other Information:** None

2.3 Master Thesis

<table>
<tr><td colspan="7">Master Thesis/Master Colloquium</td></tr>
<tr><td colspan="2">Code Number:
Ma-IMES-Thesis</td><td>Workload:
900 h</td><td>Credit Points:
30</td><td>Term:
4. Sem.</td><td>Frequency:
WiSe/SoSe</td><td>Duration:
1 Semester</td></tr>
<tr><td>1</td><td colspan="3">Courses:
a) Master Thesis
b) Master Colloquium</td><td>Contact Time:</td><td>Self-study:</td><td>Size:</td></tr>
<tr><td>2</td><td colspan="6">Goals of Qualification:
Students will achieve the ability to work on complex scientific problems independently. A successful master thesis must match scientific standards and an adequate level of written skills.</td></tr>
<tr><td>3</td><td colspan="6">Contents:</td></tr>
<tr><td>4</td><td colspan="6">Type of Course:</td></tr>
<tr><td>5</td><td colspan="6">Status of the Module in the Program:
Mandatory Module in the IMES-Program</td></tr>
<tr><td>6</td><td colspan="6">Requirements for Participation:
Students must have successfully completed semester 1,2 and 3 of the IMES program</td></tr>
<tr><td>7</td><td colspan="6">Type of Course:</td></tr>
<tr><td>8</td><td colspan="6">Requirements for Allocation of Credit Points:
Credit points are allocated when examinations of the parts have been successfully completed with the minimum grade sufficient (4.0).</td></tr>
<tr><td>9</td><td colspan="6">Significance of the Grading in the final Grade:
25% (30 LP)</td></tr>
<tr><td>10</td><td colspan="6">Person in Charge:
a) Master Thesis Supervisor</td></tr>
<tr><td>11</td><td colspan="6">Other Information:
None</td></tr>
</table>

3. Studienhilfen

3.1. Exemplarischer Studienverlaufsplan IMES:

1. und 2. Semester

1. Semester	2. Semester	Credits (1. und 2. Semester)
Pflicht:		
Introduction to Env. Sciences (inkl. Exkursionen) - Pflicht	Exkursionen	6 Credits
Gewählt:		
Meteorology	Meteorology	6 Credits
Ecology	Ecology	6 Credits
	Environmental Economics	6 Credits
Education	Education	6 Credits
Environmental Law	Environmental Law	6 Credits
Geosphere	Geosphere	6 Credits
Environmental Medicine	Environmental Medicine	6 Credits
Environmental Management		3 Credits
Hydrology		3 Credits
	GIS	3 Credits
Introduction to Environmental Statistics		3 Credits
		Ergibt insgesamt: 60 Credits

Alternativ können auch folgende Module gewählt werden:

Atmospheric Chemistry (1 Semester – 6 Credits)

Environmental Politics (1-2 Semester – 6 Credits)

Anthropology (1-2 Semester – 6 Credits)

Environmental Sociology (1 Semester – 3 Credits)

Introduction to Environmental Chemistry (1 Semester – 3 Credit Points)

3. Semester

Pflicht:	
Integrated Advanced Module in Environmental Sciences	6 Credits
Gewählt:	
Atmosphere	12 Credits
Environmental Law	12 Credits
	Ergibt insgesamt: 30 Credits

Alternativ können auch folgende Module gewählt werden:

Biosphere (12 Credits)

Geosphere (12 Credits)

Hydrosphere (12 Credits)

Environmental Policy & Management (12 Credits)

Political Ecology & Environmental Governance (12 Credits)

Environmental Spatial Methods (12 Credits)

4. Semester

Pflicht:	
Erarbeitung der Masterthesis mit anschließender mündlicher Verteidigung	30 Credits
	Ergibt insgesamt: 30 Credits

3.2 Fach- und Prüfungsberatung

Fachstudienberatung:

Dr. Hülsberg und Mr. Stefan Grønnerud
Lehrstuhl für US-amerikanisches Recht
0221/1682 1594
Imes-info(at)uni-koeln.de

Studienkoordination:

Prof. Dr. Kirk Junker
Lehrstuhl für US-amerikanisches Recht
0221/1682 1594
Imes-info(at)uni-koeln.de

3.3 Weitere Informations- und Beratungsangebote

Homepage des Studiengangs und des Lehrstuhls für US-amerikanisches Recht

- http://www.imes.uni-koeln.de/
- http://www.us-recht.jura.uni-koeln.de

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Studierenden Service Center
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Daneben stehen den Studierenden an der Universität zu Köln weitere Beratungsangebote zur Verfügung, von denen die wichtigsten in der folgenden Tabelle aufgelistet sind:

Studierendensekretariat	Fragen zur Einschreibung, Rückmeldung etc.
Kölner Studentenwerk	Soziale Aspekte im Zusammenhang mit dem Studium
ASTA	Studierendenvertretung
Rektoratsbeauftragter für Menschen mit Behinderung	Studieren mit Behinderung
Akademisches Auslandsamt	Studieren mit Migrationshintergrund
Zentrale Gleichstellungsbeauftragte	Vereinbarkeit von Familie und Studium, Sexualisierte Diskriminierung

Annex – Kooperation mit der TH Köln

Im Rahmen der Kooperation mit der TH Köln (Institute for Technology and Resources Management in the Tropics and Subtropics) können Kurse aus dem Angebot des Institutes während des dritten Semesters belegt werden. Diese Kurse können ein Modul während der Spezialisierung im dritten Semester ersetzen (12 Leistungspunkte). Die hier beschriebenen Kurse stehen beispielhaft für ein sehr breites Kursangebot. In Einzelfällen kann es zu Restriktionen bei der Kurswahl durch die TH Köln kommen (Bsp. Erforderliche Vorkenntnisse sind nicht vorhanden)

Name of Module	**Photovoltaic and Solar Thermal Systems**			**Course Code**	**E-05**
	Core	**Methods and Tools**	**IWRM**	**NRM**	**REM**
Module Catalog					**x**
Credit Points	**SWS**	**Attendance (h)**	**Self-study (h)**	**Total workload (h)**	
5	3	50	100	150	
	Term			**Language**	
	Summer			English	
Prerequisites					
Competencies	**After completion of the module students** Explain the physics of solar radiation Describe the functionality of photovoltaic and thermal solar systems Develop concepts of solar based district energy supply systems Estimate dimensions and economics of solar based district energy supply systems Discuss the sustainability and the reliability of solar based district energy supply systems				
	Photovoltaics (16) Principles of solar cells and of solar radiation, PV modules, PV system configuration, grid connected and island PV system sizing, simulation of PV systems based on PVSOL **Solar thermal systems (16)** Energy transformation: radiation to heat collector types and heat transfer mechanisms Energy transformation: heat to electricity				

Content	thermal power plants and low temperature transformation (ORC) Solar energy application process heat and cooling application (air conditioning) **Project: Development of an energy concept for a small district (18)** Groups get the task to develop a combined electrical and heat concept for a district. The district of each group has different peripheral conditions such as climate data, degree of development, infrastructure, industry, inhabitants The students decide on applied technologies and components based and discuss their decisions in the group The students present their concept in final presentation
Teaching Methods	Lecture, group work, exercises, plenary discussions
Assessment Method	Written examination: 70%, Project work /Presentation: 30%
Recommended Reading	Solar Energy Engineering: Processes and Systems. Author: Author: Soteris A. Kalogirou, Publisher: Academic Press Solar Electricity Handbook - 2013 Edition: A Simple Practical Guide to Solar Energy - Designing and Installing Photovoltaic Solar Electric Systems. Author: Michael Boxwell, Publisher: Greenstream Publishing Solar Engineering of Thermal Processes. Authors: John A. Duffie, William A. Beckman, Publisher: Wiley Thermodynamics: an Engineering Approach, Cengel, Yunus A./ Boles, Michael A, 2010 McGraw-Hill, New York More: to be announced in the classroom
Module Coordinator	Ulf Blieske
Lectureres	Ulf Blieske, Christiane Lambers
Version	31.01.2014

Name of Module	Wind Energy and Hydro Power			Course Code	E-07
	Core	Methods and Tools	IWRM	NRM	REM
Module Catalog					x
Credit Points	SWS	Attendance (h)	Self-study (h)	Total workload (h)	
5	3	50	100	150	
	Term			Language	
	Winter			English	
Prerequisites					
Competencies	**After completion of the module, the students** Understand the physics of wind energy Design wind energy projects and use wind park planning tools (e.g. WINDPRO) Analyse wind energy systems Understands the principles to use hydro power in order to generate electricity				
Content	**Wind energy (32h)** Wind resources, physics of wind, aerodynamics Wind measurements History of wind power, types of wind turbines Nacelle, power train, gear, breaks, etc. Electrical Systems for wind turbines Control aspects Power and energy yield of wind turbines Planning and operation of wind turbines **Wind project planning (WindPro) (15h)** Introduction into the wind park planning software WindPRO Conduction of a wind park planning project **Hydropower (3h)**				

	Technologies of hydro power applications Basics of power generation with different hydro sources Run-of-the-river power plants Stored and pumped stored hydro power Tidal power, marine currents and wave energy
Teaching Methods	Lecture, group work, exercises
Assessment Method	Written examination: 50%, Case study (individual or) group report: 50%
Recommended Reading	European Wind Atlas Erich Hau: Windkraftanlagen Siegfried Heier: More to be announced in the classroom
Module Coordinator	Ingo Stadler
Lecturers	Ingo Stadler

Name of Module	**Decentralized Energy Systems Planning**			**Course Code**	**E-08**
	Core	**Methods and Tools**	**IWRM**	**NRM**	**REM**
Module Catalog					**x**
Credit Points	**SWS**	**Attendance (h)**	**Self-study (h)**	**Total workload (h)**	
5	3	45	105	150	
	Term			**Language**	
	Winter			English	
Prerequisites	None				
	After completion of the module, the students Understand the basics of energy systems planning procedure Analyse (calculate and simulate) the sectorial energy demand (electrical, thermal, etc.)				

Competencies	Calculate the (renewable) energy resource potential Calculate (design) the supply system Analyse the supply alternatives (stand alone, mini-grids, etc.) Perform the economic feasibility study of the developed project Research the other factors that have influence on the developed project (political, social, environmental, etc.) Make a decision on implementation of the developed project Learn to deal with the other stakeholders (investors, policy makers)
Content	**Basics of energy planning (6h)** Energy planning theories and models, decentralized energy supply system characteristics, rural electrification – principle and practices, etc. Energy planning tool - LEAP **Energy demand assessment (6h)** Holistic sectorial (household, industrial, etc.) energy demand characteristics (electrical, thermal, etc.), demand analysis methods, energy demand data collection procedures and analyses, energy demand calculation and forecasting, etc. **Energy supply system (20h)** Energy resources assessment and analysis for the site under study, renewable resources and technology selection methodologies, selection of proper supply infrastructure alternatives (decentralized vs. central), sizing of the energy supply systems required to meet energy demand (electrical, thermal, etc.), simulation of hybrid energy systems (e.g. use of HOMER software), etc. **Economics of the supply system (5h)** Economic analysis methods for energy supply systems, business and financing models, rural energy supply projects operation models **Decision making (8h)** Environmental, policy, regulatory and other factors relevant to the energy supply systems for the site under study Socio-economic impacts of the supply systems
	Sustainable operation models
Teaching Methods	Lecture, project work
Assessment Method	Presentation: 30%, project work group report: 70%
Recommended	Rural Electrification Through Decentralized Off-grid Systems in Developing

Reading	Countries. Author: Bhattacharyya (Ed.), Publisher: Springer More: to be announced in the classroom
Module Coordinator	Ramchandra Bhandari
Lecturers	Ramchandra Bhandari
Version	31.01.2014

Name of Module	**Energy Efficiency and Environment**			**Course Code**	**E-04**
	Core	**Methods and Tools**	**IWRM**	**NRM**	**REM**
Module Catalog					**x**
Credit Points	**SWS**	**Attendance (h)**	**Self-study (h)**	**Total workload (h)**	
5	3	45	105	150	
	Term			**Language**	
	Summer			English	
Prerequisites	None				
Competencies	**After completion of the module, the students** Analyse the energy efficiency measures Carry out the feasibility study of different energy efficient technologies Analyse efficiency measures in residential, commercial, industrial and transport sector Analyse the emissions from industry, trade, residential areas and traffic Evaluate the material flow management in renewable energy technologies Prepare inventory database Calculate life cycle impact categories of energy technologies Evaluate the environmental impact assessment of renewable energy projects Describe the GHG emission mitigation and adaptation measures for conventional plants, e.g. CCS				
	Energy and Environment (9h)				

Content	Energy consumption and climate change Energy saving strategies for reducing climate change impacts Evaluation of emissions from defined and diffusive sources from industry, residential areas, traffic, etc. Greenhouse gases reduction policies Environmental impact assessment **Energy efficiency principles and practices (14h)** Residential sector Industrial sector Transport sector Production and planning sectors **Energy efficiency regulations (9h)** Energy efficiency norms and standards (e.g. in EU and Germany) Feasibility of energy efficiency projects **Life cycle assessment (18h)** Environmental life cycle assessment (LCA) (ISO 14040 and 14044) in details LCA simulation tools (open LCA, Gabi, etc.) Sustainable life cycle assessment - life cycle costing and social life cycle assessment
Teaching Methods	Lecture, project work, exercises
Assessment Method	Written examination: 50%, Project work report: 50%