Eberswalde University for Sustainable Development

Module catalogue

Global Change Management (M.Sc.)

valid from winter term 2021/2022

Content

1. Semester GCM

M Human nature and wellbeing

Semester:	1
Module coordinator:	Prof. Dr. Martin Welp (martin.welp@hnee.de)
Status:	Mandatory
Goal:	Students are enabled to understand and analyse the social and ecological basis of human wellbeing. They acquire skills to detect and document human-nature interactions in space and time, both on the local and the global level. Students learn to conceptualize and critically assess different ways of measuring human wellbeing within planetary boundaries
Examination form	Project presentation (100%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Human and nature wellbeing

Semester:	1
Coordinator:	Prof. Dr. Martin Welp
Lecturer:	Prof. Dr. Martin Welp, Prof. Dr. Pierre Ibisch, Prof. Dr. Hartmut Ihne, Prof. Dr. Hermann Ott
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Teaching form	Lecture (15 h), Seminar (15 h), Project (30 h), self-study (90 h)
Max. study places	-
Language:	English
Module type	continuous
Examination form	Project presentation (100%)
Entry requirements	-
Goal:	Students are enabled to understand and analyse the social and ecological basis of human well-being. They acquire skills to detect and document

human-nature interactions in space and time, both on the local and the global level. Students learn to conceptualize and critically assess different ways of measuring human well-being within planetary boundaries.

Content:

Starting with the local level, students take part in an excursion to a case study region and assess human-nature interaction in the past and present. The material and immaterial needs are documented and patterns of dependencies are detected. This analysis takes place mainly on local level is later in the course extended to universal needs of people and the culturally specific need satisfiers.

On a conceptual level (in classroom), human wellbeing is discussed and modelled using the local level analysis as inspiration and complementing it with philosophical perspectives and readings on conceptualization of human well-being, development and good life. Students are enabled to understand and analyse dimensions of and factors contributing to human wellbeing. They elaborate a framework for the analysis of development goals and challenges going beyond a strict dichotomy between factual and value judgments.

Different measurement tools and their underlying assumptions are studied and applied to assess human wellbeing. The shortcomings of gross domestic product (GDP) as a metric for well-being is discussed. Alternative ways of measuring such indexes and their components are analysed and discussed for their similarities and differences. These include, among others, Human Development Index, Gross National Happiness, OECD Better Life Index and Social Progress Index.

The module concludes with a consensus classification for essential elements of human wellbeing, which builds the basis for the follow-up module on system functionality.

Recommended related elective modules :

Competences :

Technical competence (25%), Social competence (25%), Personnel competence (25%), Media competence (25%)

Literature:

Alkire, S. (2002). Dimensions of human development. World development, 30(2), 181-205.

Introduction to the Amartya Sen's Capability Approach by S. Alkire: URL: https://www.youtube.com/watch?v=3IaGY31ktx0

Millward-Hopkins, J., Steinberger, J. K., Rao, N. D., & Oswald, Y. (2020). Providing decent living with minimum energy: A global scenario. Global Environmental Change, 65, 102168

OECD Better Life Index: URL http://www.oecdbetterlifeindex.org/de

WHO Millennium Ecosystem Assessment report 2005. Ecosystems and Human Wellbeing. Health Synthesis (URL: http://www.who.int/globalchange/ecosystems/ecosys.pdf).

M Fundamentals of systems functionality and change

Semester:	1
Module coordinator:	Prof. Dr. Pierre Ibisch (pierre.ibisch@hnee.de)
Status:	Mandatory
Goal:	Students are enabled to understand the ecosystems and social systems relevant to human wellbeing. This includes understanding the functioning of both ecosystems and social systems, structures and processes that are crucial for their maintenance (functions), and the services derived from them for humans. Furthermore, students shall understand the inherently indeterminate dynamics of ecological or social systems. This enables students to critically discuss the weaknesses and strengths of the approach of social-ecological systems. They are able to derive requirements and limits for the management of complex systems.
Examination form	Project presentation (100%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Fundamentals of systems functionality and change

Semester:	1
Coordinator:	Prof. Dr. Martin Welp
Lecturer:	Prof. Dr. Pierre Ibisch, Prof. Dr. Martin Welp. Prof. Dr. Manfred Stock (PIK) et al.
ECTS-Credits:	9
SWH:	6
Workload:	225 h / Semester
Teaching form	Lecture (10 h), Seminar (20 h),Project (60 h), Self-study (150 h)
Max. study places	-
Language:	English
Module type	blocked

Examination form	Project presentation (100%)
Entry requirements	-
Goal:	Students are enabled to understand the ecosystems and social systems relevant to human wellbeing. This includes understanding the functioning of both ecosystems and social systems, structures and processes that are crucial for their maintenance (functions), and the services derived from them for humans. Furthermore, students shall understand the inherently indeterminate dynamics of ecological or social systems. This enables students to critically discuss the weaknesses and strengths of the approach of social-ecological systems. They are able to derive requirements and limits for the management of complex systems.
Content:	This module investigates what systems actually are and how they function. Systemics is introduced as way of inquiry and model for understanding more or less complex, nested and interacting entities that make up our known world. System science is used for bridging historically induced gaps between social and natural sciences. The homology of social and 'natural' systems is discussed, as well as the question if it is possible to derive lessons from ecosystems for the functioning and sustainable development of social systems (concept of econics). The concept of sustainable development itself is discussed as an emergent property of complex systems, which might exist beyond normative ideas and integrates system properties and drivers related to efficiency and resilience. The role of energy (and exergy) in systems function, development and evolution is studied. Selected systems are analysed in greater depth. This concept is applied to the anthroposystem (the entirety of social systems), ecosystems and the climate system.
Recommended related elective modules :	
Competences :	Technical competence (30%), Methodological competence (30%), Social competence (20%), Personnel competence (20%)
Literature:	Bunge, M., 2000. Systemism: the alternative to individualism and holism. The Journal of Socio-Economics 29, 147--157. (http://ceses.cuni.cz/CESES-137-version1-1B_BUNGE_Systemism.pdf) Ibisch, P.L. 2019. Systems theory: towards a holistic and interdisciplinary understanding of sustainable development, in: Ibisch, P.L., H. Molitor, A. Conrad, H. Walk, V. Mihotovic & J. Geyer (eds.): Humans in the global ecosystem. An introduction to sustainable development. Oekom Verlag, München, 409 pp. (ISBN 9783962381172), 59-82. Ibisch, P.L., L. Geiger & F. Cybulla (eds.) 2012. Global change management: knowledge gaps, blindspots and unknowables. Nomos, Sinzheim. Ibisch, P.L. & P.R. Hobson (eds.) 2014. The MARISCO method: Adaptive MAnagement of vulnerability and RISk at COnservation sites. A guidebook for risk-robust, adaptive, and ecosystem-based conservation of biodiversity. Centre for Econics and Ecosystem Management, Eberswalde (ISBN 978-3-00-043244-6). 195 pp.

Ibisch, P.L., A. Vega E. & T.M. Herrmann (eds.) 2010. Interdependence of biodiversity and development under global change. Technical Series No. 54. Secretariat of the Convention on Biological Diversity, Montreal, 224 pp. (ISBN 92-9225-279-8) (online http://www.cbd.int/doc/publications/cbd-ts-54-en.pdf).

Jorgensen SE An integrated ecosystem theory. (http://www.eurasc.org/annals/docs/Jorgensen_TeamR_f(15).pdf)

Jorgensen, S.E. 2012. Introduction to Systems Ecology (Applied Ecology and Environmental Management) Crc Pr Inc

Kay JJ, Boyle M 2008. Self-Organizing, Holarchic, Open Systems (SOHOs) In: The ecosystem approach. Complexity, uncertainty, and managing for sustainability, ed. Waltner-Toews D (Columbia Univ. Press, New York), 51-78.

Laszlo, A. / Krippner, S. 1998. Systems theories: their origins, foundations, and development. In: J.S. Jordan (ed.): Systems theories and a priori aspects of perception. Elsevier Science, 47-74.

Luhmann, N. 1987. Soziale Systeme. Grundriß einer allgemeinen Theorie (Suhrkamp, Frankfurt/Main).

Meadows, D.H., Meadows, G., Randers, J., and Behrens, W.W. III. 1972. The Limits to Growth. New York: Universe Books.

Mobus, G.E. & M. C. Kalton 2014. Principles of Systems Science (Understanding Complex Systems)

Vester, F. 2008. The Art of interconnected thinking: Tools and concepts for a new approach to tackling complexity; Munich, MCB.

Von Bertalanffy, L. 1972. The History and Status of General Systems Theory The Academy of Management Journal, Vol. 15, No. 4, General Systems Theory (Dec., 1972), 407-426. (http://systemotechnica.ucoz.com/_fr/1/Bertalanffy_L.V.pdf)

Wright, D., & Meadows, D. H. (2008). Thinking in systems. Earthscan.

M Drivers of stress to system functionality and root causes

Semester:	1
Module coordinator:	Prof. Dr. Pierre Ibisch (pierre.ibisch@hnee.de)
Status:	Mandatory
Goal:	Students will be enabled to systemically understand and analyse human activities that directly or indirectly lead to stresses on biological and social systems, which thus pose relevant challenges to ecosystem functioning and human well-being. To this end, at the completion of the module, students will have learned approaches to terminological classifications, taking the drivers of stress and their root causes as an example. They have practiced identifying their systemic relationships. They have applied basic knowledge of risk management to the development of future scenarios and the identification of risks and blind spots. Finally, they have practiced prioritisation of problems by assessing their criticality and strategic relevance.
Examination form	Project report (50%), Project presentation (50%)
ECTS-Credits:	9
SWH:	6

Module Component 1 Drivers of stress to systems functionality

Semester:	1
Coordinator:	Prof. Dr. Pierre Ibisch
Lecturer:	Dr. Stefan Kreft, Prof. Dr. Andreas Linde, Prof. Dr. Manfred Stock (PIK), Prof. Dr. Martin Welp, Prof. Dr. Pierre Ibisch
ECTS-Credits:	2
SWH:	2
Workload:	50 h / Semester
Teaching form	Lecture (8h), Seminar (12h), Practical exercise (10h), Self-study (20h)
Max. study places	-
Language:	English
Module type	blocked

Examination form	-
Entry requirements	-
Goal:	Students will be enabled to systemically understand and analyse human activities (“drivers of stress”) that directly lead to stresses on biological and social systems. To this end, at the completion of this module component, students will have learned approaches to terminological classifications, taking the drivers of stress as an example. They have applied basic knowledge of risk management to the development of future scenarios and the identification of risks and blind spots. Finally, they have practiced prioritisation of problems by assessing the criticality and strategic relevance of drivers of stress.
Content:	Having understood the fundamentals of systems functionality, in this module component students learn about mechanisms and dynamics of human activities that directly threaten social and ecological systems functioning (“drivers of stress”). Drivers of stress negatively alter the state of systems’ key attributes required for functionality. Their systemic relationships (nestedness, cause-effect webs, positive feedback loops) are analysed. Existing direct threats as well future risks are discussed by applying the concept of vulnerability. Direct threats and associated risks are classified according to their sources. Analyses follow the MARISCO (Adaptive MAnagement of RISks and Vulnerability at COnservation Sites) Method. For documentation and visualisation, students start systematising the acquired insights in a conceptual model. This is done by means of a workshop-style combination of introductory inputs, work in small groups and reviews in the plenary.
Recommended related elective modules :	
Competences :	Technical competence (30%), Methodological competence (30%), Social competence (20%), Personnel competence (10%), Media competence (10%)
Literature:	Ibisch, P.L., L. Geiger & F. Cybulla (eds.) 2012. Global change management: knowledge gaps, blindspots and unknowables. Nomos, Sinzheim. Ibisch, P.L. & P.R. Hobson (eds.) 2014. The MARISCO method: Adaptive Management of vulnerability and RISk at COnservation sites. A guidebook for risk-robust, adaptive, and ecosystem-based conservation of biodiversity. Centre for Econics and Ecosystem Management, Eberswalde (ISBN 978-3-00-043244-6). 195 pp. Salafsky, N. et al. 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. Conservation Biology, 22: 897-911. DOI: 10.1111/j.1523-1739.2008.00937.x

Module Component 2 Root causes of systems dysfunctionality

Semester:	1
Coordinator:	Prof. Dr. Pierre Ibisch
Lecturer:	Dr. Stefan Kreft, Prof. Dr. Carsten Mann, Christoph Nowicki, Prof. Dr. Hermann Ott, Prof. Dr. Manfred Stock, Prof. Dr. Martin Welp, Prof. Dr. Pierre Ibisch
ECTS-Credits:	7
SWH:	4
Workload:	175 h / Semester
Teaching form	Lecture (15h), Seminar (20h), Practical exercise (25h), Self-study (115h)
Max. study places	-
Language:	English
Module type	blocked
Examination form	Project report (50%), Project presentation (50%)
Entry requirements	-
Goal:	Students are enabled to systemically understand and analyse those social framework characteristics which are the "root causes", indirectly leading to stresses on biological and social systems. To this end, at the completion of this module component, students will have further practiced approaches to terminological classifications, using the root causes of problems as an example. They have practiced identifying their systemic relationships. They have applied basic knowledge of risk management to the development of future scenarios and the identification of risks and blind spots. Finally, they have practiced prioritisation of problems by assessing the criticality and strategic relevance of root causes.
Content:	In this module component students learn about mechanisms and dynamics of root causes that result from local, regional and/or global change processes underlying drivers of stress to social and ecological systems' functioning. Root causes embrace, among others, factors from biophysical, socioeconomic and governance domains. Their systemic relationships (nestedness, cause-effect webs, positive feedback loops) are analysed. Existing root causes as well as future associated potential future threats ('risks') are discussed by applying the concept of vulnerability. The module component comprises fundamentals of risk management, including the relevance of cognitive bias in ignoring or misinterpreting relevant threats and risks. Root causes and associated risks are classified according to their sources. As in the first component of this module, analyses follow the MARISCO Method and continue to be carried out in a workshop style. The newly acquired insights about root causes bring the conceptual model to completion.

Recommended related elective modules :

Competences :

Technical competence (40%), Methodological competence (20%), Social competence, (20%), Personnel competence (10%), Media competence (10%)

Literature:

Ibisch, P.L. & P.R. Hobson (eds.) 2014. The MARISCO method: Adaptive Management of vulnerability and RISk at COnservation sites. A guidebook for risk-robust, adaptive, and ecosystem-based conservation of biodiversity. Centre for Econics and Ecosystem Management, Eberswalde (ISBN 978-3-00-043244-6). 195 pp.
Ibisch, P.L., L. Geiger & F. Cybulla (eds.) 2012. Global change management: knowledge gaps, blindspots and unknowables. Nomos, Sinzheim.

Sutherland, W. J. et al. 2020. A horizon scan of emerging global biological conservation issues for 2020. Trends in Ecology & Evolution, 35: 81-90. (And subsequent issues.)

UNEP 2019. Global Environment Outlook – GEO-6: Healthy planet, healthy people. United Nations Environment Programme, Nairobi. DOI: 10.1017/9781108627146. (And subsequent issues.)

UNEP 2019. Frontiers 2018-19 Emerging Issues of Environmental Concern. United Nations Environment Programme, Nairobi. (And subsequent issues.)

World Economic Forum (2020). The Global Risks Report 2020. URL: http://www3.weforum.org/docs/WEF_Global_Risk_Report_2020.pdf. (And subsequent issues.)

E Carbon sequestration and accounting

Semester:	1
Module coordinator:	Prof. Dr. Martin Guericke (Martin.Guericke@hnee.de)
Status:	Elective
Goal:	Students understand the carbon cycle with special reference to forests, soils and forest products. They are qualified to develop and critically reflect forest growth scenarios and have acquired basic knowledge of the purpose and the implementation of life cycle analysis (LCA), product carbon footprints (PCF) and corporate carbon footprints (CCF).
Examination form	Work report (100%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Carbon Sequestration and accounting

Semester:	1
Coordinator:	Prof. Dr. Martin Guericke
Lecturer:	Prof. Dr. Martin Guericke, Prof. Dr. Tobias Cremer, Prof. Dr. Winfried Riek
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Teaching form	Lecture (30h), Project (30h), self-study (90h)
Max. study places	8 (+ 8 FST + 8 FIT)
Language:	English
Module type	blocked
Examination form	Work report
Entry requirements	-

Goal:

Students understand the carbon cycle with special reference to forests, soils and forest products. They are qualified to develop and critically reflect forest growth scenarios and have acquired basic knowledge of the purpose and the implementation of life cycle analysis (LCA), product carbon footprints (PCF) and corporate carbon footprints (CCF).

Content:

The interactions among vegetation, climate and soil properties as main factors influencing soil carbon storage will be explained. In terms of carbon sequestration the current EU-wide programs for observing and monitoring the element budget in forest ecosystems are presented. An overview of global threats to soils in particular by loss of humus and measures for soil protection will be given.

Finally forest yield and growth is modelled according to common, traditional approaches as well as to new tools like statistical computer growth models (BWinPro). In this context current trends and available tools in forest growth modelling are presented. Students carry out self-selected and self-defined case studies focused on carbon sequestration. Additionally the participants learn about the problems and challenges to include the dynamic change of management strategies, effects of climate change and the general change of site conditions in growth modelling and to evaluate the results of growth scenarios.

Secondly rules for the development of LCA (life cycle analysis), layout, structure and boundaries of LCA; PCF (product carbon footprints) and CCF (corporate carbon footprints) will be presented. Basic knowledge of the purpose and the implementation of life cycle analysis (LCA), product carbon footprints (PCF) and corporate carbon footprints (CCF) will be given. Moreover it will be discussed which data are needed to develop a LCA, how such data are collected and how the calculation is done. In this context important tools and software for the calculation of LCA will be explained.

Recommended related elective modules :

Competences :

Technical competence (50%), Methodological competence (20%), Social competence (10%), Personnel competence (20%)

Literature:

V. Gadow, K., Pukkala, T. A., Tome, M., 2000. Sustainable Forest Management. Kluwer Academic Publishers.

Jandl, R., Rodeghiero, M., Olsson, M. 2011. Soil carbon in Sensitive European Ecosystems: From Science to Land Management, John Wiley & Sons. Ltd. Olsthoorn et al. 1999. Management of mixed-species forest: silviculture and economics. IBN Scientific Contributions 15, Wageningen.

Pommerening, A. a. Murphy, S.T., 2004. A review of the history, definitions and methods of continuous cover forestry with special attention to afforestation and restocking. Forestry, Vol. 77, No. 1, 27-44

E Academic writing and presenting

Semester:	1
Module coordinator:	Language Centre (SPZ) NN (Sprachenzentrum@hnee.de)
Status:	Elective
Goal:	Students can understand and apply the principles of academic writing and presenting. They can communicate effectively in an academic context.
Examination form	Oral report (100%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Academic writing and presenting

Semester:	1
Coordinator:	Language Centre NN
Lecturer:	Language Centre NN
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Teaching form	Seminar (60h), self-study (90h)
Max. study places	25
Language:	English
Module type	blocked
Examination form	Oral report (100%)
Entry requirements	-
Goal:	Students can understand and apply the principles of academic writing and presenting. They can communicate effectively in an academic context.
Content:	This module imparts the principles of academic writing and presenting. Students analyse academic papers and presentations and work individually on short texts and presentations. Course objectives are:

- to differentiate between different kinds of writing tasks in an academic context
- to analyse writing tasks and structure texts accordingly
- to find appropriate text types for academic work
- to take notes effectively
- to develop a critical approach to reading
- to know how to use citation conventions
- to avoid plagiarism
- to understand the importance of proofreading and editing
- to understand the requirements of presenting in an academic context
- to present with confidence in an academic context

A particular emphasis is put on individual academic work and on individual needs and difficulties.
The examination form is a presentation held by students at the end of the course.

Recommended related elective modules :

Competences : Methodological competence (50%), personal competence (50%)

Literature:

Bailey, S. (2017). Academic Writing. A Handbook for International Students (5th ed.). Routledge.

Burton, G. (2014). Presenting: Deliver Presentations with Confidence (2nd ed.). Collins.

E Fundamentals of measurements and modelling

Semester:	1
Module coordinator:	Prof. Dr. Luis Miranda (luis.miranda@hnee.de)
Status:	Elective
Goal:	The students get to know different automated measurement methods in the environmental sector. They are able to identify and discuss the data origins and to assess the data quality of a measurement. They process data in environmental modelling and apply the building methodology behind mathematical models in environmental science, forestry and ecology.
Examination form	Technical discussion 20 min (50%), Term paper (50%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Sensor for automated measurements

Semester:	1
Coordinator:	Prof. Dr. Luis Miranda
Lecturer:	Prof. Dr. Luis Miranda
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (12h), Practical exercise (18h), Self-study (45h)
Max. study places	-
Language:	English
Module type	blocked
Examination form	Technical discussion (50%)
Entry requirements	-

Goal:	The students identify and describe the measuring principles behind sensor technologies used as data sources for environmental modelling. They know the principles of data quality assessment and further data processing procedures that guarantee a meaningful re-use of the measured data.
Content:	The course focuses on field data acquisition to support the construction and tuning of ecosystem and environmental models. The knowledge of different measuring principles is important for the processing, analysis and evaluation of sensory recorded environmental data and helps with the interpretation of ecosystem phenomena. The most important sensors for automatic field measurements are presented alongside their physical measuring principles and technical usage constrains. The parts of an automatic measuring system are presented and discussed, as well as the concepts of sensor resolution and accuracy. The concepts of analog to digital conversion, signal conditioning, interfaces and noise are reviewed. Practical exercises show the sensor construction and their installation and calibration, particularly sensors for temperature, relative humidity, solar radiation and soil water content. Practical troubleshooting and testing techniques are presented to assess the state of the sensors.
Recommended related elective modules :	
Competences :	Technical competence (50%) Methodological competence (40%) Personal competence (10%)
Literature:	Fritschen, L. J., & Gay, L. W. (2012). Environmental instrumentation. Springer Science & Business Media. Pearcy, R. W., Ehleringer, J. R., Mooney, H., & Rundel, P. W. (Eds.). (2012). Plant physiological ecology: field methods and instrumentation. Springer Science & Business Media.

Module Component 2 Process modelling methodology

Semester:	1
Coordinator:	Dr. Evelyn Wallor
Lecturer:	Dr. Evelyn Wallor
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (15 h), Practical exercise (15 h), Self-study (45 h)
Max. study places	-
Language:	English

Module type	blocked
Examination form	Term paper (50%)
Entry requirements	-
Goal:	The students know about application areas of ecosystem models and are able to distinguish between different modelling concepts. They have a broad overview of different models and tools related to different focuses on environmental processes, e.g. carbon dynamics, water- and nutrient cycling, and biomass growth. Students learn the principles of modelling practice in terms of parameter estimation, model set-up, and model validation. They conceptualize and design mathematical models to be used in environmental science, forestry and ecology. The students define input and output variables as well as protocols for modelling exercises.
Content:	The course refreshes fundamental knowledge about ecosystems with respect to definitions, terms, and processes (e.g. element cycling, mass balance), and introduces the role and purpose of model applications in environmental science (e.g. large scale scenarios, retrospective evaluation). Based on relevant scientific findings from the field of modelling different models and modelling approaches are explored (e.g. quantitative vs. dynamic, point vs. terrain model). Building on this, students set up various ordinary differential equations to simulate exemplarily forest biomass growth (e.g. logistic growth, Gompertz growth). They extend the growth models with terms for carbon accounting depending on tree age and tree species. Furthermore, they conduct parameterisation and model curve fitting by applying the least squares method on selected process equations. Finally, measures for model validation to assess models' outcome are introduced and trained (e.g. RMSE, IA, MAE). All methods are trained and practiced in connection with the module component "Sensors for automated measurements" using the software R and RStudio.
Recommended related elective modules :	
Competences :	e.g. Technical competence (50%) Media competence (10%) Methodological competence (30%) Personal competence (10%)
Literature:	Ahuja, Laj R., Ma, L. (Eds.) (2011). Methods of Introducing System Models into Agricultural Research. ASA-CSSA-SSSA Book. DOI:10.2134/advagricsystmodel2 Teh, C. (2006). Introduction to mathematical modeling of crop growthhow the equations are derived and assembled into a computer model. Brown Walker Press. Wendroth, O., Lascano, R.J., Ma, L. (Eds.) (2019). Bridging Among Disciplines by Synthesizing Soil and Plant Processes. ASA-CSSA-SSSA Book. DOI:10.2134/advagricsystmodel8 additional relevant literature and current scientific resources will be provided by the lecturer

E Earth System Analysis and Stewardship

Semester:	1 and 2
Module coordinator:	Prof. Dr. Manfred Stock (manfred.stock@hnee.de)
Status:	Elective
Goal:	Students are enabled to understand the theoretical fundamentals of global climate change and cross-scale impacts within their regional context. On the example of recent and ongoing projects they will learn about solutions, strategies and management options, considering the importance of stakeholders' uncertainty and risk perceptions and different decision-making contexts.
Examination form	Project Presentation (50%), Project Presentation (50%)
ECTS-Credits:	6
SWH:	4

Module Component 1 Earth System Analysis

Semester:	1
Coordinator:	Prof. Dr. Manfred Stock
Lecturer:	Prof. Dr. Manfred Stock, Dr. Fred Hattermann
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (10h), Seminar (10h), Project (10h), Self-study (45h)
Max. study places	-
Language:	English
Module type	blocked
Examination form	Projekt Presentation (50%)

Entry requirements	-
Goal:	To enable students to understand the theoretical fundamentals of global climate change and subsequent cross-scale impacts, and their regional manifestation in different environmental settings considering the interlinkages with human activities.
Content:	The Paris Agreement demands ambitious global efforts to limit the increase in global mean surface temperature to well below 2°C and to increase resilience and adaptive capacity and thereby reduce vulnerability to the impacts of climate change. However, the likelihood of missing out on these targets is very high and increasing. Impact assessments based on the current state-of-the-art unanimously suggest that without suitable adaptation actions the enhanced impacts due to overshooting or unmitigated climate change are likely to be severe, subject to large regional variations, and largely linked to an increased frequency and intensity of extreme events with potentially catastrophic consequences for human and natural systems. Within this module the students will study the physical fundamentals of global climate change and better understand the cross-scale impacts of climate change and their regional manifestations in different environmental settings. A focus is on water and water related impacts, extremes and sectors, starting from the global water cycle as part of earth's climate (coupled dynamics). In subsequent lectures they will learn about interlinkages and feedbacks within the water-vegetation-food-energy-health nexus and interactions with human activities. The causes and impacts of hydroclimatic extremes will be worked out. Students learn basic features of climate and hydrological modelling and scenario-building and become literate in reading state to the art climate research results.
Recommended related elective modules :	
Competences :	Technical competence (50%), Methodological competence (30%), Personnel competence (10%), Media competence (10%)
Literature:	Schellnhuber, H. J. (1999). 'Earth system'analysis and the second Copernican revolution. Nature, 402(6761), C19-C23. URL: https://www.nature.com/articles/35011515 Messner, D., Schlacke, S., Fromhold-Eisebith, M., Grote, U., Matthies, E., Pittel, K., ... & Blake-Rath, R. (2019). Towards Our Common Digital Future. Flagship Report. German Advisory Council on Global Change (WBGU). Schellnhuber, H. J., Messner, D., Leggewie, C., Leinfelder, R., Nakicenovic, N., Rahmstorf, S., ... & Schubert, R. (2011). World in transition: a social contract for sustainability. WBGU. Rethinking Land in the Anthropocene: from Separation to Integration. WBGU (forthcoming, available 2021) Kraas, F., Leggewie, C., Lemke, P., Matthies, E., Messner, D., Nakicenovic, N., ... & Butsch, C. (2016). Humanity on the move: Unlocking the transformative power of cities. WBGU-German Advisory Council on Global Change.

Schellnhuber, H. J., Hare, B., Serdeczny, O., Schaeffer, M., Adams, S., Baarsch, F., ... & Piontek, F. (2013). Turn down the heat: climate extremes, regional impacts, and the case for resilience. Turn down the heat: climate extremes, regional impacts, and the case for resilience.

Masson-Delmotte, V., Zhai, P., Pörtner, H. O., Roberts, D., Skea, J., Shukla, P. R., ... & Connors, S. (2018). Global warming of 1.5 C. An IPCC Special Report on the impacts of global warming of, 1. .5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty

Watson, R. T., Noble, I. R., Bolin, B., Ravindranath, N. H., Verardo, D. J., & Dokken, D. J. (2000). IPCC special report on land use, land-use change, and forestry.

IPCC AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability (selected chapters

10. Kerres, M., Servos, M., Kramer, A., Hattermann, F., Tänzler, D., Pilz, T. and Mueller, A. (2020): Stop Floating, Start Swimming: Water and climate change -- interlinkages and prospects for future action. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Bonn/Eschborn, Germany

Module Component 2 Earth System Stewardship

Semester:	2
Coordinator:	Prof. Dr. Manfred Stock
Lecturer:	Prof. Dr. Manfred Stock, Dr. Fred Hattermann
ECTS-Credits:	3
SWH:	2
Workload:	75 h / Semester
Teaching form	Lecture (15 h), Practical exercise (15 h), Self-study (45 h)
Max. study places	-
Language:	English
Module type	blocked
Examination form	Project Presentation 50%
Entry requirements	-
Goal:	To enable students, on the example of recent and ongoing projects, to understand and critically reflect different mitigation and adaptation

solutions, strategies and management options, considering the relevance of stakeholders' uncertainty and risk perceptions and different decision-making contexts.

Content:

Based on the earlier module on the analysis of the earth system (winter semester) this module will focus on solutions, strategies and management options, again with a focus on climate change impacts on water and water related sectors including agriculture, forestry, water supply and power production. Experiences show that current adaptation activities are often highly heterogeneous, not linked across sectors and fail to meet the needs of end-users and stakeholders. Stakeholder involvement and embedded knowledge co-production processes are often weak or critically missing; in turn, such services usually fail to recognize the importance of, e.g., decision-making contexts, stakeholders' uncertainty and risk perceptions, and the potential role of socio-economic 'tipping points'.

On the example of recent and current studies with focus on mitigation and adaptation to climate change the students will learn about mitigation and adaptation strategies and measures at different regional scales and governance levels. They will elaborate why sustainable transformation pathways ideally combine high level decision making and local action. Most studies and projects presented and examined are located in highly vulnerable regions worldwide such as Bangladesh, Sub-Saharan Africa, Central Asia and South America, but also in Europe (Mediterranean, Central Europe, Germany).

Recommended related elective modules :

Competences :

Technical competence (50%), Methodological competence (30%), Personnel competence (10%), Media competence (10%)

Literature:

Schellnhuber, H. J. (1999). 'Earth system'analysis and the second Copernican revolution. Nature, 402(6761), C19-C23. URL: https://www.nature.com/articles/35011515

Messner, D., Schlacke, S., Fromhold-Eisebith, M., Grote, U., Matthies, E., Pittel, K., ... & Blake-Rath, R. (2019). Towards Our Common Digital Future. Flagship Report. German Advisory Council on Global Change (WBGU).

Schellnhuber, H. J., Messner, D., Leggewie, C., Leinfelder, R., Nakicenovic, N., Rahmstorf, S., ... & Schubert, R. (2011). World in transition: a social contract for sustainability. WBGU.

Rethinking Land in the Anthropocene: from Separation to Integration. WBGU (forthcoming, available 2021)

Kraas, F., Leggewie, C., Lemke, P., Matthies, E., Messner, D., Nakicenovic, N., ... & Butsch, C. (2016). Humanity on the move: Unlocking the transformative power of cities. WBGU-German Advisory Council on Global Change.
Schellnhuber, H. J., Hare, B., Serdeczny, O., Schaeffer, M., Adams, S., Baarsch, F., ... & Piontek, F. (2013). Turn down the heat: climate extremes, regional impacts, and the case for resilience. Turn down the heat: climate extremes, regional impacts, and the case for resilience.

Masson-Delmotte, V., Zhai, P., Pörtner, H. O., Roberts, D., Skea, J., Shukla, P. R., ... & Connors, S. (2018). Global warming of 1.5 C. An IPCC Special Report on the impacts of global warming of, 1. .5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty

Watson, R. T., Noble, I. R., Bolin, B., Ravindranath, N. H., Verardo, D. J., & Dokken, D. J. (2000). IPCC special report on land use, land-use change, and forestry.

IPCC AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability (selected chapters

10. Kerres, M., Servos, M., Kramer, A., Hattermann, F., Tänzler, D., Pilz, T. and Mueller, A. (2020): Stop Floating, Start Swimming: Water and climate change -- interlinkages and prospects for future action. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Bonn/Eschborn, Germany

E Specialisation module

Semester:	1 or 2
Module coordinator	Head of study programme
Status:	Elective
Goal:	Students deepen their professional knowledge and skills in a specific area, that is of special interest for them. Students can identify their personal interests in the field of global change management and expand their horizon to approaches in related study programmes.
Examination form:	
ECTS-Credits:	6
SWH:	4

Module component 1 Specialisation module

Semester:	1, 2
Coordinator	Head of study programme
Lecturer	NN
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Max. study places:	
Teaching form:	
Language:	
Module type:	
Examination form:	
Entry requirements:	
Goal:	Students deepen their professional knowledge and skills in a specific area, that is of special interest for them. Students can identify their personal

	interests in the field of global change management and expand their horizon to approaches in related study programmes.
Content:	The contents of the module depend on the individual offer or selection. Courses can be chosen - from other curricula of the Department of Forest and Environment, other study programs of the HNEE, other universities in Germany and abroad or scientific institutions; or - which are newly developed and offered by lecturers without curricular commitment, e.g. in the context of research and development projects, and by are evaluated and approved by the head of the study program after application as qualifying in the sense of the program objectives.
Recommended related elective modules :	
Competences:	
Literature:	

M Strategies for change and transformation

Semester: 2

Module coordinator: Prof. Dr. Martin Welp (martin.welp@hnee.de)

Status: Mandatory

Goal: Students are enabled to adopt relevant principles of proactive strategic thinking for complex systems management and understand past and present societal transitions, their underlying patterns and key actors. Furthermore, students can evaluate different strategies of transformation on different levels and know how to apply tools to identify high leverage points in different kinds of complex systems.

Examination form: Project presentation (50%), Technical discussion (50%)

ECTS-Credits: 9

SWH: 7

Module component 1 Strategies for change and transformation

Semester: 2

Coordinator: Prof. Dr. Martin Welp

Lecturer: Prof. Dr. Martin Welp, Prof. Dr. Pierre Ibisch, Prof. Dr. Hartmut Ihne, Christoph Nowicki, Christian Barthelt (MunichRe Foundation) et al.

ECTS-Credits: 9

SWH: 7

Workload: 225 h / Semester

Max. study places -

Teaching form Lecture (15h), Seminar (20h), Project (45h), self-study (145h)

Language: English

Module type: blocked

Examination form:	Project Presentation (50%), Technical Discussion (50%)
Entry requirements:	
Goal:	Students are enabled to adopt relevant principles of proactive strategic thinking for complex systems management and understand past and present societal transitions, their underlying patterns and key actors. Furthermore, students can evaluate different strategies of transformation on different levels and know how to apply tools to identify high leverage points in different kinds of complex systems.
Content:	Strategies are conceptualized as goal-oriented interventions in complex systems. Based on the understanding of systems theory the practice of strategic thinking and planning is critically reflected. Exemplary societal transformation processes with global relevance are analysed in terms of their underlying drivers, dynamics, and actors. The module aims at developing proactive and evidence-based strategies and view these in face of non-knowledge and uncertainty. Sustainability transitions are discussed with a special focus on climate change related issues. Different mitigation options are analysed from the broad portfolio of technological, forest-based, geo-engineering and lifestyle based climate mitigation. The principles of adaptive management are introduced by using practical examples related to natural resources. Different perspectives from the Global North and the South are discussed. Our partner organisation, Munich Re Foundation provides a perspective from the insurance and risk management perspective. In accompanied group work students work on topics that are related to both Munich Re (such as corporate sustainability) and the Foundation (such as livelihoods, micro-insurance).
Recommended related elective modules:	Systems Leadership
Competences:	Technical competence (30%), Social competence (25%), Personnel competence (25%), Media competence (20%)
Literature:	WBGU 2011. World in Transition – A Social Contract for Sustainability Malik, F. 2013. Strategy: Navigating the Complexity of the New World. Campus Verlag. Senge et al. 2008. The necessary revolution: How individuals and organizations are working together to create a sustainable world Waddell, S., Waddock, S., Cornell, S., Dentoni, D., McLachlan, M., & Meszoely, G. (2015). Large systems change: An emerging field of transformation and transitions. Journal of Corporate Citizenship, (58), 5-30.

M Implementation of change management

Semester:	2
Module coordinator:	Prof. Dr. Martin Welp (martin.welp@hnee.de)
Status:	Mandatory
Goal:	Students are able to initiate and implement transitional changes by acquiring skills for global leadership aimed at a sustainability transition.
Examination form:	Term paper (50%), Oral Report (50%)
ECTS-Credits:	9
SWH:	7

Module component 1 Implementation of change management

Semester:	2
Coordinator:	Prof. Dr. Martin Welp
Lecturer:	Prof. Dr. Martin Welp, Christoph Nowicki, N.N. (Germanwatch), N.N. (NABU)
ECTS-Credits:	9
SWH:	7
Workload:	225 h / Semester
Max. study places	-
Teaching form	Lecture (20h), Seminar (30h), Project (30h), self-study (145h)
Language:	English
Module type:	blocked
Examination form:	Term paper (50%), Oral Report (50%)
Entry requirements:	-
Goal:	Students are able to initiate and implement transitional changes by acquiring skills for global leadership aimed at a sustainability transition.

Content:	The module gives an overview of main approaches to Organisational learning and related tools of change management, including knowledge and non-knowledge management. In particular, students focus on deepening their understanding of interventions, alliance building and conflict management. Learning processes and tools to accelerate transformation of organisations are evaluated and tested by analysing exemplary social systems in view of their explicit or implicit agreements. The role of NGOs in transformation processes is analysed together with our partner organisation NABU and Germanwatch. At NABU students focus on issues such as lobbying and campaigning to influence decision makers. Germanwatch provides contents related to applied climate policy, covering different topical issues around the UN Climate Convention. If feasible students participate in the international climate negotiations to get first hand impressions on negotiation practice. The module lays foundations of skills for global leaders. Improving collaborative leadership skills for transformation and deepening knowledge on practical approaches lead and build thriving organizations and change processes are at the focus of the module.
Recommended related elective modules:	
Competences:	Technical competence (30%), Social competence (20%), Personnel competence (20%), Media competence (10%)
Literature:	Holman, P., Devane, T., & Cady, S. (2007). The change handbook: Group methods for shaping the future. Berrett-Koehler Publishers. di San Giorgio, L. T. (2016, June). Understanding Multi-Stakeholder Dialogue. In AUS Business and Peace Conference: A Special Theme Issue of Business, Peace and Sustainable Development (Issue 7) (Vol. 7, p. 8). Greenleaf Publishing. Climate Interactive. Climate Change Solutions Simulator. URL: https://www.climateinteractive.org/tools/en-roads/ GCM 2019. Compendium 2019. A collection of selected approaches to initiate and implement transitional change. 197 p. GCM 2018. A Roadmap for Large Scale Societal Change. Yearly Compendium. 136 p.

E Global change and development

Semester:	2
Module coordinator:	Christoph Nowicki (Christoph.nowicki@hnee.de)
Status:	Elective
Goal:	The students gain the ability to critically reflect approaches to development and development cooperation as well as trends of change and challenges. They are able to formulate constructive proposals for effective project design and implementation especially addressing drivers and impacts of global change.
Examination form:	Project Presentation (100%)
ECTS-Credits:	6
SWH:	4

Module component 1 Global change and development

Semester:	2
Coordinator:	Christoph Nowicki
Lecturer:	Christoph Nowicki, (GIZ) NN
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Max. study places	16
Teaching form	Lecture (10h), Seminar (20h), Project (30h), self-study (90h)
Language:	English
Module type:	blocked
Examination form:	Project Presentation
Entry requirements:	-

Goal:	The students gain the ability to critically reflect approaches to development and development cooperation as well as trends of change and challenges. They are able to formulate constructive proposals for effective project design and implementation, paying particular attention to the drivers and impacts of global change.
Content:	Having analysed both theory and conceptual evolution of development, development policy and international cooperation, students reflect key actors and current approaches. Staff of Deutsche Gesellschaft für Internationale Zusammenarbeit - GIZ reports on real-life challenges to international cooperation and presents trends of change, current strategies and methods used in their practical work. Student groups conduct research on selected topics related to programmes, projects or methods, with particular emphasis on aspects of global change, sustainability and systemics. GIZ staff and HNEE lecturers provide supervision and coaching. Students conclude their research with a final presentation summarizing their findings and recommendations.
Recommended related elective modules:	
Competences:	Technical competence (40%), Social competence (20%), Personnel competence (20%), Media competence (20%)
Literature:	Burton, I., & M. van Aalst 2004. Look before you leap: a risk management approach for incorporating climate change adaptation into World Bank operations. (https://www.researchgate.net/publication/259842151_Look_Before_You_Leap_A_Risk_Management_Approach_for_Incorporating_Climate_Change_Adaptation_in_World_Bank_Operations) Cornwall, A. & D. Eade, 2010. Deconstructing Development Discourse: Buzzwords and Fuzzwords. Oxfam. (https://oxfamilibrary.openrepository.com/handle/10546/118173) Donella H. Meadows et al. 1972. The Limits to growth; a report for the Club of Rome's project on the predicament of mankind. New York: Universe Books (https://clubofrome.org/publication/the-limits-to-growth/) Hopkin M. 2007. Climate takes aim. Nature 2007, 446: 706-707. (https://www.nature.com/articles/446706a) Joyeeta Gupta 2009. Climate change and development cooperation: trends and questions, Current Opinion in Environmental Sustainability, Volume 1, Issue 2, (http://www.sciencedirect.com/science/article/pii/S1877343509000347) Maxton, G.P. & Randers, Jorgen. (2016). Reinventing Prosperity. (https://clubofrome.org/publication/reinventing-prosperity-2016/) Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

(https://www.millenniumassessment.org/documents/document.356.aspx.pdf
)

UNDP 2015. Reducing Disaster Risk, A Challenge for Development (https://www.undp.org/content/undp/en/home/librarypage/crisis-prevention-and-recovery/reducing-disaster-risk--a-challenge-for-development.html)

USAID 2007. Adapting to climate variability and change: a guidance manual for development planning (https://pdf.usaid.gov/pdf_docs/PNADJ990.pdf)

Further informative sites:

- https://clubofrome.org/publication/
- https://germanwatch.org/en/publications
- https://www.are.admin.ch/are/en/home/sustainable-development/international-cooperation/2030agenda/un-_-milestones-in-sustainable-development.html
- https://www.un.org/en/
- https://sdgs.un.org/

E Natural Resource Management in Transformation Countries

Semester:	2
Module coordinator:	Prof. Dr. Pierre Ibisch (pierre.ibisch@hnee.de)
Status:	Elective
Goal:	Students acquire a critical understanding of the challenges for sustainable development in transformation countries and are able to propose strategic elements for addressing challenges identified in a concrete case-study region.
Examination form:	Project presentation (50%), Project report (50%)
ECTS-Credits:	6
SWH:	4

Module component 1 Natural resource management in transformation countries

Semester:	2
Coordinator:	Prof. Dr. Pierre Ibisch
Lecturer:	Ibisch, Welp.
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Max. study places	10
Teaching form	Lecture (10h), Seminar (20h), Practical Exercise (30h), self-study (90 h)
Language:	English
Module type:	blocked
Examination form:	Project report (50%), Project Presentation (50%)

Entry requirements:	-
Goal:	Students acquire a critical understanding of the challenges for sustainable development in transformation countries and are able to propose strategic elements for addressing challenges identified in a concrete case-study region.
Content:	Transition countries are countries such as for example the successor states of the former Soviet Union who are in transition (transformation) from the centrally planned economy to a market economy system and are often marked by the fundamental change or replacement of the political regime. The transition countries are sometimes counted among the developing countries. Many former transformation countries today are already part of the OECD or EU countries. The framework and challenges for natural resource protection are influenced by economic and political upheaval, while worsening as well as improving the environmental situation in relation to selected parameters. During the visit of a selected region in a transformation country, students will perform a situation analysis with the use of literature and conducting interviews or small empirical social studies. This analysis includes plausible scenarios of local, regional and global change. Based on this analysis, practical management and development proposals will be developed.
Recommended related elective modules:	
Competences:	Technical competence (40%), Methodological competence (30%), Social competence (20%), Personnel competence (10%)
Literature:	

E System leadership and societal transformations

Semester:	2
Module coordinator:	Prof. Dr. Martin Welp (martin.welp@hnee.de)
Status:	Elective
Goal:	To enable students to understand the theoretical and methodological fundamentals of systems leadership and to acquire leadership skills for large scale systems change.
Examination form:	Project presentation (100 %)
ECTS-Credits:	6
SWH:	4

Module component 1 Systems leadership and societal transformation

Semester:	2
Coordinator:	Prof. Dr. Martin Welp
Lecturer:	NN
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Max. study places	20
Teaching form	Lecture (20h), Seminar (20h), Project (20h), self-study (90h)
Language:	English
Module type:	blocked
Examination form:	Project Presentation (100%)
Entry requirements:	Fundamentals of systems functionality and change

Goal:	To enable students to understand the theoretical and methodological fundamentals of systems leadership and to acquire leadership skills for large scale systems change.
Content:	The module focuses on how to use systems mapping as a leadership tool for change. Students will acquire leadership skills on a real life case on which systems mapping is applied. Students will get experience in interacting with people in leadership roles and be empowered to actively contribute to change. They learn how to strategically build career relevant relations using online tools and how to conduct leadership interviews using semi-structured expert interviews. Readings provide a conceptual and theoretical framework on large scale system change and provide tools for self-assessment and personal development. Students will learn various forms of self-reflection and how to create social media content.
Recommended related elective modules:	
Competences:	Technical competence (25%), Social competence (25%), Personnel competence (25%), Media competence (25%)
Literature:	Dreier et al. 2019. Systems Leadership for Sustainable Development: Strategies for Achieving Systemic Change. Harvard Kennedy School. 48 p. Waddell, S. 2018. Four Strategies for Large Systems Change. Stanford Social Innovation Review. Spring 2018: 41-45. URL https://www.youtube.com/watch?v=ZS5y--ODWeU&list=PLsJWgOB5mIMCAD33pve6_HyfuGTlCTQgd https://www.youtube.com/watch?v=w4mNTvaPhOU&list=PLsJWgOB5mIMBAAVcll-BvYbPuD3EpX2a3 Guidelines for Drawing Causal Loop Diagrams, by: Daniel H. Kim, The Systems Thinker, Vol 3, No 1, pp5-6 (Feb 1992). https://www.cs.toronto.edu/~sme/SystemsThinking/GuidelinesforDrawingCausalLoopDiagrams.pdf Lehmann, H. (Ed.). (forthcoming). The Kwawu resilient entrepreneurial ecosystems: A complex adaptive systems approach to achieving the Sustainable Development Goals. In Sustainable Development and Resource Productivity (1st Edition). Routledge. https://www.routledge.com/Sustainable-Development-and-Resource-Productivity-The-Nexus-Approaches/Lehmann/p/book/9780367429546

E Transformation Pioneers

Semester:	2
Module coordinator:	Prof. Dr. Heike Walk (heike.walk@hnee.de)
Status:	Elective
Goal:	Students are able to apply competences in interdisciplinary scientific work and self-management in order to plan their own transformation project of moderate scope. The orientation of the project corresponds to the goals of the study programme and leads to an entrepreneurship that supports sustainability transformation.
Examination form:	Project report (100%)
ECTS-Credits:	6
SWH:	4

Module component 1 Transformation Pioneers

Semester:	2
Coordinator:	Prof. Dr. Heike Walk
Lecturer:	Prof. Dr. Heike Walk
ECTS-Credits:	6
SWH:	4
Workload:	150 h / Semester
Max. study places	-
Teaching form	Lecture (10h), Seminar (20h), Project (30h), Self-study (90h)
Language:	English
Module type:	blocked
Examination form:	Project report (100%)
Entry requirements:	Fundamentals of systems functionality and change

Goal:	Students are able to apply competences in interdisciplinary scientific work and self-management in order to plan their own transformation project of moderate scope. The orientation of the project corresponds to the goals of the study programme and leads to an entrepreneurship that supports sustainability transformation.
Content:	The module component deals with all relevant aspects of planning a project: defining aims and target groups; developing the strategy; planning the implementation of the project in terms of tasks, costs, team and time; and developing a fundraising strategy. We will reflect on the things we are concerned about with regards to the way our society is organized. We will gather these topics and talk about the obvious key aspects of an unsustainable growth. We look at the role of social movements in modern societies and assess why they are important for certain phases. Based on this, we plan our own transformation project.
Recommended related elective modules:	
Competences:	Technical competence (30%), Methodological competence (30%), Social competence (20%), Personnel competence (20%)
Literature:	German Advisory Council on Global Change (WBGU), 2011: World in Transition - A Social Contract for Sustainability German Advisory Council on Global Change (WBGU), 2014: Climate Protection as a World Citizen Movement, Berlin Hamann, A., Zea-Schmidt, C., Leinfelder, R. (eds.) 2014: The Great Transformation. Climate - Can We Beat the Heat? Berlin Mc Call, B./ von den Dool, J. , 2013: Hosting Transformation" - Pioneers of Change, Melk, Donau, Austria

M Research Project

Semester:	3
Module coordinator:	Prof. Dr. Martin Welp (Martin.Welp@hnee.de)
Status:	Mandatory
Goal:	Students are enabled to plan and accomplish a research project of moderate size related to the study programme's content.
Examination form:	Project report (not graded)
ECTS-Credits:	24
SWH:	20

Module component 1 Research Project

Semester:	3
Coordinator:	Prof. Dr. Martin Welp
Lecturer:	Prof. Dr. Martin Welp, Christoph Nowicki et al.
ECTS-Credits:	24
SWH:	20
Workload:	600 h / Semester
Max. study places	-
Teaching form	Project (300 h), self-study (300h)
Language:	English
Module type:	blocked
Examination form:	Project report
Entry requirements:	

Goal:	Students are enabled to plan and accomplish a research project of moderate size related to the study programme's content.
Content:	Students design a scientific project related to global change management in cooperation with an organisation within the field of research, management, consulting, business or campaigning. While doing so, selected, topics of the curriculum are deepened both in terms of contents and methods. Students demonstrate their topical knowledge about the selected research problem, but also show their abilities to present it in a convincing manner. Students learn to have a scientific debate and deal with feedback. Furthermore, students analyse the working culture and processes in the involved organisation, such as explicit or implicit agreements, work flows, learning culture, strategies, etc. The research project results as well as the results of the inquiry of the organisation are presented in a final report.
Recommended related elective modules:	
Competences:	Technical competence (20%), Methodological competence (20%), Social competence (20%), Personnel competence (20%), Media competence (20%)
Literature:	Linnenluecke, M.K. and A. Griffiths 2010. Corporate sustainability and organizational culture. Journal of world business, Elsevier Punch, K.F. 2005. Introduction to Social Research–Quantitative & Qualitative Approaches. London: Sage Yin, R. K. (2004). The case study anthology. Sage.

M Internet Based Research Colloquium

Semester:	3
Module coordinator:	Prof. Dr. Martin Welp (Martin.Welp@hnee.de)
Status:	Mandatory
Goal:	Students are able to discuss and present current research topics, accompanying the research projects of the third semester students.
Examination form:	Term paper (not graded)
ECTS-Credits:	6
SWH:	2

Module component 1 Internet Based Research Colloquium

Semester:	3
Coordinator:	Prof. Dr. Martin Welp
Lecturer:	Prof. Dr. Martin Welp
ECTS-Credits:	6
SWH:	2
Workload:	150 h / Semester
Max. study places	-
Teaching form	Seminar (30h), self-study (120h)
Language:	English
Module type:	blocked
Examination form:	Term paper
Entry requirements:	

Goal:	Students are able to discuss and present current research topics, accompanying the research projects of the third semester students.
Content:	The course provides an online-platform for the presentation and discussion of the research projects selected by the third semester students. At the beginning of the module, each student will present her/his intended research project to the semester and module instructor by posting an exposé (one page, not more than 800 words) on the online-platform. The exposé will be put under scrutiny and discussed by the students and module instructor. Questions and problems occurring during the research project will be discussed.
Recommended related elective modules:	
Competences:	Technical competence (30%), Methodological competence (30%), Personnel competence (30%), Media competence (10%)
Literature:	Linnenluecke, M.K. and A. Griffiths 2010. Corporate sustainability and organizational culture. Journal of world business, Elsevier Punch, K.F. 2005. Introduction to Social Research–Quantitative & Qualitative Approaches. London: Sage Yin, R. K. (2004). The case study anthology. Sage.

M Master thesis colloquium

Semester:	4
Module coordinator:	Prof. Dr. Martin Welp (Martin.Welp@hnee.de)
Status:	Mandatory
Goal:	Students acquire further skills in interdisciplinary scientific work. They are enabled to evaluate research projects and to communicate results to expert and lay audience.
Examination form:	Project presentation
ECTS-Credits:	4
SWH:	2

Module component 1 Master thesis colloqium

Semester:	4
Coordinator:	Prof. Dr. Martin Welp
Lecturer:	Prof. Dr. Martin Welp, Christoph Nowicki
ECTS-Credits:	4
SWH:	2
Workload:	100 h / Semester
Max. study places	-
Teaching form	Seminar (30h), self-study (70h)
Language:	English
Module type:	blocked
Examination form:	Project presentation
Entry requirements:	

Goal:	Students acquire further skills in interdisciplinary scientific work. They are enabled to evaluate research projects and to communicate results to expert and lay audience.
Content:	The course provides a platform for academic discussions of the master thesis research projects conducted by the fourth semester students. Each student presents her/his masters project by giving a short presentation on theoretical/conceptual frameworks, research design and methods and expected results. This should be based on a sound knowledge of the state-of-the-art research in the respective field of research. The presentation will be discussed and scientifically debated by a predefined commentator (fellow students) and thereafter by the whole semester and the module instructor. Alternative paths, open questions and possible problems that may occur during the research project will be discussed in a constructive style.
Recommended related elective modules:	
Competences:	Technical competence (30%), Methodological competence (30%), Social competence (20%), Personnel competence (20%)
Literature:	

M Master thesis and defence

Semester:	4
Module coordinator:	Prof. Dr. Martin Welp (Martin.Welp@hnee.de)
Status:	Mandatory
Goal:	Students obtain own research results while solving and discussing a scientific problem. Students present the research results of their master thesis and are able to defend its underlying assumptions, methodologies, and robustness of the key findings.
Examination form:	Project report (70%), Project presentation (30%)
ECTS-Credits:	26
SWH:	20

Module component 1 Master thesis and defence

Semester:	4
Coordinator:	Prof. Dr. Martin Welp
Lecturer:	Prof. Dr. Martin Welp, Christoph Nowicki et al.
ECTS-Credits:	26
SWH:	20
Workload:	650 h / Semester
Max. study places	-
Teaching form	Project (300 h), self-study (350h)
Language:	English / German (tbd)
Module type:	continuous
Examination form:	Project report (70%), project presentation (30%)
Entry requirements:	

Goal:	Students obtain own research results while solving and discussing a scientific problem. Students present the research results of their master thesis and are able to defend its underlying assumptions, methodologies, and robustness of the key findings.
Content:	The students conduct a scientific analysis and report on a specific topic related to the study programme's content. The topic of the scientific analysis relates broadly to contents of GCM, and can range from natural scientific to social scientific research questions and apply various quantitative and qualitative research methods. Students show their ability to apply recent scientific results and to derive new consolidated findings on the basis of their topical and methodological knowledge. Main parts of the thesis are the motivation and practical definition of the topic, the formulation of research targets and questions, the annotated representation of the state-of-the-art including prevailing theories, as well as the own contribution for reaching the assumed targets. The social and political relevance of the research topic should be pronounced. For this reason cooperation with companies, NGOs and public administrative bodies is encouraged and supported. Students are furthermore encouraged to conduct projects with an inter- or transdisciplinary research approach. In a public master thesis defence, students present their individual research results as academic personalities. The disputation takes 45 minutes and consists of a 20 minutes presentation targeted at an academic audience, covering the scientific, social and political relevance of the research questions, selected theoretical and conceptual frameworks, research design and methods, results and a critical reflection of the results and the research process. In the following discussion (up to 30min), questions concerning the thesis as well as its social/political and methodological context will be asked, showing also the systemic comprehension of the analysis.
Recommended related elective modules:	
Competences:	Technical competence (30%), Methodological competence (30%), Social competence (10%), Personnel competence (30%)
Literature:	