Module Handbook

M.Sc. Polar and Marine Sciences
POMOR

April 2013

Universität Hamburg

DER FORSCHUNG | DER LEHRE | DER BILDUNG

Content

Contact

University of Hamburg

Prof. Dr. Eva-Maria Pfeiffer,
Prof. Dr. Lars Kutzbach
Universität Hamburg, Institut für Bodenkunde
Allende-Platz 2
20146 Hamburg
Germany
Tel. +49 40 42838 4194
Fax +49 40 42838 2024
Email: empfeiffer@ uni-hamburg.de

Saint Petersburg State University

Prof. Dr. Jörn Thiede
Dr. Grigory Fedorov
Saint Petersburg State University, Faculty for Geography and Geoecology
33, 10th line V.O.
199178 St. Petersburg
Russia
Tel.: +7 812 323 9976
Fax: +7 812 323 9976
Email: jthiede@geomar.de, g.fedorov@geo.spbu.ru

Prof. Dr. Georgy Cherkashov
Saint Petersburg State University, Faculty of Geology
Universitetskaya nab. 7-9
199034 St. Petersburg
Russia
Tel.: +7 812 713 83 78
Email: Cherkashov@vniio.ru

POMOR Secretariat at the Saint Petersburg State University

M.Sc. Polar and Marine Sciences POMOR
c/o Saint Petersburg State University, Faculty for Geography and Geoecology
33, 10th line V.O.
199178 St. Petersburg
Russia
Tel.: +7 812 323 9976
Fax: +7 812 323 9976
Email: secretariat@pomor.org
http://www.pomor.spbu.ru

Coordination office at the GEOMAR Helmholtz Centre for Ocean Research Kiel

Dr. Heidemarie Kassens
Dr. Nadezda Kakhro
Wischhofstr. 1-3
24148 Kiel
Germany
Tel. +49 431 600 2850, +49 431 600 2852
Fax +49 431 600 2961
Email: hkassens@geomar.de, nkakhro@geomar.de

Contact person at the University of Hamburg, M.Sc. ICSS
Prof. Dr. Carsten Eden
Grindelberg 5
20146 Hamburg
Germany
Tel. +49 40 42838 7623
Fax:+49 40 42838 4938
Email: carsten.eden@zmaw.de

Contact person at the University of Bremen
PD Dr. Holger Auel
FB 02: Biology/Chemistry
Postfach 330440
28334 Bremen
Germany
Tel. +49 421 218 63040
Fax +49 421 218 62808
Email: hauel@uni-bremen.de

Contact person at the Christian Albrecht University of Kiel
Prof. Dr. Wolf-Christian Dullo
Wischhofstr. 1-3
24148 Kiel
Germany
Tel. +49 431 600 2215
Fax +49 431 600 2925
Email: cdullo@geomar.de

Contact person at the University of Potsdam
Prof. Dr. Hans-Wolfgang Hubberten
Karl-Liebknecht-Str. 24-25
14476 Potsdam-Golm
Germany
Tel. +49 331 288 2100
Fax +49 331 997 5700
Email: hubbert@awi.de

Structure scheme of the M.Sc. POMOR

Module No.	Semester, module type and teaching and learning methods	Work load	SWH	CP
Compulsive C. Elective El, Lecture L, Practical training P, Seminar S, Excursion E.				
1st semester (winter semester = WS), St. Petersburg State University, Russia Russian and German lecturers				
1.	Ocean basins, sediments and climate change; C; L, P, S, E	270	6	9
2.	High seas and coastal waters oceanography; C; L, P, S, E	270	6	9
3.	Polar and marine ecosystem: structure, functioning and vulnerability: C; L, P, S, E	270	6	9
Core	Core Part 1: C; L, P, S, E	60	2	2/6
	Sum	**870**	**20**	**29**
2nd semester (summer semester = SS), St. Petersburg State University, Russian and German lecturers				
4.	Natural resources: C; L, P, S, E	270	6	9
5.	Processes in the coastal zone and environmental management; C; L, P, S, E	270	6	9
6.	Periglacial environment: C; L, S	270	6	9
Core	Core Part 2: C; L, S, P incl. field practice	120	2	4/6
	Sum	**930**	**20**	**31**
3d semester (winter semester = WS), Germany)				
	Semester abroad at one of the partner universities in Germany, El: Specialization, Electives, Additionals -University of Hamburg, M.Sc. Integrated Climate System Sciences (ICSS); -University of Bremen, M.Sc. Marine Biology; -Christian Albrecht University of Kiel, M.Sc. Marine Geosciences; -University of Potsdam, M.Sc. Geosciences/ Geology	900	20	30
	Sum	**900**	**20**	**30**
4th semester (summer semester = SS), Russia or Germany				
	Master thesis in polar and marine sciences with Defence: C	900	20	30
	Sum	**900**	**20**	**30**
	Total for the M.Sc. Polar and Marine Sciences	**3600**	**80**	**120**

Term 1 (WS) **Russia,** St. Petersburg State University	**Module 1** Ocean basins, sediments and climate change **CP 9**	**Module 2** High seas and coastal waters oceanography **CP 9**	**Module 3** Polar and marine ecosystem: structure, functioning and vulnerability **CP 9**	**Core Module** Part 1 **CP 2/6**
Term 2 (SS) **Russia**, St. Petersburg State University	**Module 4** Natural resources **CP 9**	**Module 5** Processes in the coastal zone and environmental management **CP 9**	**Module 6** Periglacial environment **CP 9**	**Core Module** Part 2 incl. field practice in Russia or Germany **CP 4/6**
Term 3 (WS) **Germany**, Partner universities	**Semester abroad at one of the partner universities and institutions in Germany,** Specialization, Electives, Additionals: • University of Hamburg: Integrated Climate System Sciences (ICSS) • University of Bremen: Marine Biology, Geosciences • Christian Albrecht University of Kiel: Marine Geosciences • University of Potsdam: Geosciences/Geology **CP 30**			
Term 4 (SS) **Russia and Germany**	**M.Sc. Thesis Polar and Marine Sciences with Defence** • St. Petersburg State University, Russia • University of Hamburg, Germany • Alfred Wegener Institute for Polar and Marine Research, Germany • Arctic and Antarctic Research Institute, Russia • Leibniz Institute for Baltic Sea Research Warnemünde, Germany • GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany • Otto Schmidt Laboratory for Polar and Marine Research (OSL), Russia • University of Bremen, Germany • Christian Albrecht University of Kiel, Germany • University of Potsdam, Germany • University of Rostock, Germany **CP 30**			

Figure 1: Structure of the M.Sc. Program POMOR

Semester 1 – Winter Semester

Module 1 Ocean Basins, Sediments and Climate Change

Symbol	OCEAN BASINS, SEDIMENTS AND CLIMATE CHANGE
Title	Ocean Basins, Sediments and Climate Change
Learning outcomes	After completing this module, students are expected to - have a knowledge in polar marine sedimentation processes related to climate change - be able to interpret data obtained by state-of-the-art methods of marine sediment investigation (sampling, facies analysis, climate proxies, age determination) - be able to apply modern marine technologies - have basic skills in geochemical and geochronological lab investigation of marine sediments
Contents	The module concentrates on two fields of marine research: - marine geology of the seafloor and continental margins with a focus on plate tectonics of oceanic crust and morphodynamics and sedimentary budgets of deep-sea deposits - Earth's climate and its variability during geologic history with a special focus on polar regions. Advanced topics of research on climate dynamics are presented, covering climate reconstructions based on geological records and the application of lab techniques to survey recent and ancient ocean environment The module program is completed by a course on deep-sea technologies (development and use of research devices adapted for deep-sea conditions). In all courses, emphasis will be put on the application of state-of-the-art methods and on the discussion of case studies.
Educational concept	5 courses including lectures with seminars, practice and excursions: 1.1 Marine sediments and polar sedimentation processes; L, E [R. Stein, R. Rendle-Bühring] CP 3 1.2 Methods in marine geosciences; L, P, S, E [G. Fedorov, V. Kuznetsov] CP 2 1.3 Methods of seafloor mapping; L, P [S. Boltramovich] CP 1 1.4 Ocean basins: morphology, tectonic structure and dynamics; L, S [A. Krylov] CP 2 1.5 Marine geotechnology; L, E [A. Piskarev-Vasiliev] CP 1
Language	English
Formal requirements for participation	None
Recommended prerequisites	None additional

Grading framework (possibly including examinations)	Type:	1 written exam
	Requirements for registration for examination:	Participation in lectures, excursions, practical training and seminars is obligatory
	Language:	English
	Duration / size:	Max. 90 min.
	Possibly weighted by the credits for the module grade:	Average grade of the courses
Credits	9.0	
Workload	Campus study:	120 hours
	Self-study:	120 hours
	Exam preparation:	30 hours
Module type	Compulsory	
Semester	Semester 1	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Module usability	Compulsory for M.Sc. POMOR	
Module coordinator	T. Bickert, A. Krylov, V. Kuznetsov, R. Stein	
Course lecturer(s)	S. Boltramovich, G. Fedorov, A. Krylov, V. Kuznetsov, A. Piskarev-Vasiliev, R. Rendle-Bühring, R. Stein	
Literature	Anderson John. B. Antarctic Marine Geology. Cambridge University Press, Cambridge, 1999 – 292 p. Proxies in Late Cenozoic Paleoceanography, edited by C. Hillaire–Marcel and A. De Vernal (2007): Developments in Marine Geology, Vol. 1, 843 p. Deep-sea sediments, edited by H. Huneke & T. Mulder, 2011: Developments in Sedimentology. Vol. 63. Elsevier, Amsterdam. Hardbound, 849 pp. Wagner, G. A., 1998: Age Determination of young rocks and artifacts. Springer, 466 pp. Poulos H. G. Marine Geotechnics. Routledge. 1988. 473 p. Randolph M., Gourvenec S. Offshore Geotechnical Engineering. Taylor & Francis. 2011. 550 p. Kuenen H. Marine Geology. Baltzell Press. 2008. 596 p. Smith M., Paron P., Griffiths J. Geomorphological Mapping: Methods and Applications. Edited by J.F. Shroder Jr. Elsevier. 2011. 612 p. Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E

Module 2 High Seas and Coastal Waters Oceanography

Symbol	OCEANOGRAPHY	
Title	High Seas and Coastal Waters Oceanography	
Learning outcomes	After completing this module, students are expected to - know and understand the basic principals of the structure of the open ocean and coastal waters - have gained advanced knowledge of the properties of sea-water, sea ice, currents, waves, tides and acoustics - carry out independently: measurements, analysis, interpretation and data processing	
Contents	The lectures cover basic aspects of oceanography specified for the polar regions: - physical oceanography (properties of seawater, sea ice, currents, waves and tides, equations of motion and continuity of volume, geostrophic motion, wind-driven current system over the ocean, Ekman transport, dynamics of wind-driven coastal flow) - ocean-atmosphere interaction - introduction to the methods of oceanographic research and data management	
Educational concept	7 courses include lectures, seminars and practical exercises: 2.1 Oceanographic measurements and data analysis. Ocean climatology and long-term fluctuations; L, S [V. Gouretski] CP 1.5 2.2 Physics of the air-sea boundary layer; L, S, P [B. Ivanov] CP 1 2.3 Ocean currents; L, S [V. Ionov] CP 1.5 2.4 Ocean waves; L, S, P [L. Lopatukhin] CP 1.5 2.5 Basics of physical oceanography; L, S, P [A. Rubchenia] CP 1 2.6 Tides in the ocean; L, S [R. May] CP 0.5 2.7 Coastal ocean dynamics; L, S, P [H. Burchard, I. Shilov] CP 2	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	Basics in mathematics, physics and geography	
Grading framework (possibly including examinations)	Type:	1 written exam
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	Max. 90 min.
	Possibly weighted by the credits for the module grade:	Average grade of the courses
Credits	9.0	

Workload	Campus study:	120 hours
	Self-study:	120 hours
	Exam preparation:	30 hours
Module Type	Compulsory	
Semester	Semester 1 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Module usability	Compulsory for M.Sc. POMOR	
Module coordinator	V. Gouretski, V. Ionov	
Course lecturer(s)	H. Burchard, V. Gouretski, V. Ionov, B. Ivanov, L. Lopatukhin, R. May, A. Rubchenia, I. Shilov	
Literature	Brown, E. and Colling, A., 2001: Ocean Circulation. Butterworth Heinemann in association with the Open University, Oxford, 286 pp. Bowden, K.F., 1983: Physical Oceanography of Coastal Waters, Ellis Horwood Ltd., Chichester England, 302 pp. Volkov, Vladimir V., Ola M& Johannessen, Victor E. Borodachev, Gennadiy N. Voinov, Lasse Y. Petersson, Leonid P. Bobylev and Alexei V. Kouraev., 2002: Polar Seas Oceanography. An Integrated study of the Kara Sea. Springer, UK, 450 pp. Emery, William J., Richard E. Thomson 2004: Data Analysis Methods in Physical Oceanography. Second and Revised Edition. Elsevier, 638 pp. Stewart, Robert H., 2005: Introduction to physical oceanography. http://oceanworld.tamu.edu/resources/ocng_textbook/contents.html Tomczak, Matthias & J Stuart Godfrey, 2003: Regional Oceanography. http://www.es.flinders.edu.au/~mattom/regoc/pdfversion.html Pipkin, B. W., Gorsline, D.S., Casey, R.E. and Hammond, D. E., 1977: Laboratory Exercises in Oceanography. Freeman, San Francisco. 255 pp. http://www.es.flinders.edu.au/~mattom/regoc/pdfversion.html Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Module 3 Polar and Marine Ecosystem: Structure, Functioning and Vulnerability

Symbol	POLMARECO
Title	Polar and Marine Ecosystem: Structure, Functioning and Vulnerability
Learning outcomes	After completing this module, students are expected: - to understand species evolution, patterns of biodiversity and its role in a changing climate and within biogeochemical cycles - to have gained advanced knowledge of structure, functioning and vulnerability of polar and marine ecosystems - to be able to use modern methods of ecological researches, regulation, risk assessment and to construct mathematical models of the ecosystem and to study ecological processes by mathematical modelling - have gained knowledge about interaction of the biosphere with modern state of oil and gas reserves and pollution in the Arctic Ocean, prospective areas for development - to have knowledge and skills in field sampling strategy, working at special scientific equipment for analytical procedures in biology and geoecology
Contents	Different aspects of polar ecosystem functioning and man-induced effects on them are considered in this module: - specific features of polar and marine ecosystems, the role of sea-ice in polar ecosystems - terrestrial ecosystems in polar regions - marine ecosystems: sympagic, pelagic and benthic communities in polar seas from shelf to the open ocean and from microbial processes to marine mammals - introduction to multivariate statistics in community analysis and ecosystem modelling - examples of ecosystem services from selected ocean regions e.g. marine natural resources, ecological effects of using living resources (fisheries, whaling and sealing), sustainability and stability of ecosystems for biogeochemical processes, ecosystem function for society (in correspondence of module 4) - anthropogenic impacts on polar ecosystems, mineral resources exploration and its effect on climate change - methods of ecological standardization and ecological regulation. - microbial diversity in native and anthropogenically affected polar ecosystems - species and functional groups diversity from microorganisms, plankton, benthos and higher trophic levels in different terrestrial and marine polar environments - effects on biota of anthropogenic influence in polar ecosystems as indicators of ongoing change - bio-ethics and natural wildlife conservation in the framework of ecological regulation according to requirements of local states and international rules
Educational concept	8 courses include lectures with seminars and practical training: 3.1 Biodiversity in marine and polar ecosystems; L, S [U. Bathmann, H. Auel] CP 1

	3.2 Biological oceanography of pelagic ecosystems, principles, examples, future scenarios and modelling; L, S [U. Bathmann, H. Auel] CP 1 3.3 Biology and ecology of the seafloor fauna (benthos) of coastal and polar oceans; L, E [D. Piepenburg] CP 2 3.4 Introduction to the polar ecology and sea-ice ecology; L, S [M. Spindler, I. Peeken] CP 0.5 3.5 Ecological regulation of impacts on ecosystems; L, S [E. Abakumov, I. Fedorova, M. Gavrilo] CP 1,5 3.6 Biology and geoecology of polar regions; L, S, P [E. Vlasov, E. Elsukova, A. Sokolov, M. Gavrilo] CP 2 3.7 Introduction to ecosystem modeling; L, S, P [O. Savchuk, A. Sokolov, M. Nadporozhskaya] CP 0.5 3.8 Geoecology of Arctic shelf seas and utilisation of marine natural resources in polar regions; L, S, E [A. Novikhin] CP 0.5 During the semester students elaborate a student project that focus on a research topic with a theoretical and a practical part. The results are presented in the class.	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Oral presentation of the student project
	Requirements for registration for examination:	Participation in lectures, excursions, practical training and seminars is obligatory
	Language:	English
	Duration / size:	Max. 15 min. per one presentation
	Possibly weighted by the credits for the module grade:	Content of presentation: 75% Presentation: 10 % Discussion: 15 %
Credits	9.0	
Workload	Campus study:	120 hours
	Self-study:	120 hours
	Exam preparation:	30 hours
Module Type	Compulsory	
Semester	Semester 1 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Module usability	Compulsory for M.Sc. POMOR	
Module coordinator	H. Auel, U. Bathmann, I. Fedorova, D. Vlasov	
Course lecturer(s)	E. Abakumov, H. Auel, U. Bathmann, E. Elsukova, I. Fedorova, M. Gavrilo, M. Nadporozhskaya, A. Novikhin, I. Peek-	

	en, D. Piepenburg, O. Savchuk, A. Sokolov, M. Spindler, D. Vlasov
Literature	Polar Lakes and Rivers: Limnology of Arctic and Antarctic Aquatic Ecosystem, 2008. Eds. by Warwick F. Vincent and Johanna Laybourn-Parry. Oxford University Press, 327 pp. Bargagli R. Antarctic Ecosystems: Environmental Contamination, Climate Change, and Human Impact, 2005. Ecological Studies, Vol.175, Springer, 395 pp. Kaiser, M. J., Attrill, M., Jennings, S., and Thomas, D. N., 2009: Marine ecology: processes, systems, and impacts. Oxford University Press, 557 pp. Lalli, C,M & Parsons T.R. 1993 Biological Oceanography: An introduction. Pergamon Press, Oxford, 301 pp. Nybakken, J. W. and Bertness, M. D., 2004: Marine biology: an ecological approach. Benjamin/Cummings Pub Co., 579 pp. Thomas, D. N. and Dieckmann, G. S. (eds.), 2003: Sea ice: an introduction to its physics, biology and geology. Blackwell Science, Oxford, 402 pp. Polar Microbiology: The Ecology, Biodiversity and Bioremediation Potential of Microorganisms in Extremely Cold Environments. CRC Press, 2009. 424 pp. Physiology and Biochemistry of Extremophiles. Gerday, C., Glansdorff, N., eds. ASM Press, 2007. 472 pp. Ims R. & Fuglei E. 2005. Trophic interaction cycles in tundra ecosystems and the impact of climate change. Bioscience 55(4), 311−322 pp. Specific literature will be announced during the courses

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Core Module

Symbol	CORE	
Title	Core Module	
Learning outcomes	After completing this module students: - have gained soft skills and personal competence for scientific work and career - can review literature, manage and process data and publicly present scientific information - are informed about the rules of good scientific practice - have improved their English language skills - have studied history of polar regions and polar sciences - have obtained research experience during their field practice - can formulate a research hypothesis - can manage scientific data - can apply geographic information systems	
Contents	The Core Module will be taught during the two first semesters (Part 1 in the first semester, Part 2 in the second semester). This module involves the following directions: - history of polar research and scientific approaches - soft skills and scientific presentation skills (data management, presentations, posters, publications, thesis) - introduction to GIS - safeguarding good scientific practice - a student project: intensive study of a research topic, project planning, field and/or laboratory studies with the following preparation of a report and the scientific presentation at the POMOR student conference An intensive English course will be offered at the beginning of the first semester (daily, 1-30 September).	
Educational concept	5 courses include lectures, seminars and practical exercises: CM.1 Soft skills; L, P, S [R. Rendle-Bühring, H. Kassens] CP 1 CM.2 History of polar research; L [V. Lukin, J. Thiede] CP 0.5 CM.3 Introduction into usage of online scientific information; S, P [E. Razumova] CP 0.5 CM.4 Introduction GIS, soft skills and rules of good scientific practice; L, S, P [W-Ch. Dullo, R. Rendle-Bühring, E. Shalina] CP 1 CM.5 Field practice implemented in a student project incl. presentation at the POMOR student conference; P, S [S. Aplonov, V. Lukin, all module coordinators] CP 3	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	1 oral presentation after the first semester, 1 written report and 1 presentation on the POMOR students conference after the second

		semester
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	Each max. 15 minutes
	Possibly weighted by the credits for the module grade:	Average of the courses
Credits	6.0	
Workload	Campus study:	55 hours
	Self-study:	85 hours
	Exam preparation:	40 hours
Module type	Compulsory	
Semester	Semester 1, semester 2	
Frequency of offer	Every second year in winter semester and in summer semester	
Duration	2 semesters	
Module usability	Compulsory for M.Sc. POMOR	
Module coordinator	N. Kaledin, H. Kassens	
Course lecturer(s)	S. Aplonov, W.-Ch. Dullo, H. Kassens, V. Lukin, I. Razumova, R. Rendle-Bühring, E. Shalina, J. Thiede	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Semester 2 – Summer Semester

Module 4 Natural Resources

Symbol	NARES	
Title	Natural Resources	
Learning outcomes	After completing this module, students are expected to - have gained advanced knowledge of general aspects of non-living resources with special emphasis on soils, minerals, and hydrocarbons, living terrestrial and marine resources in the Arctic and their use - understand and be able to use methods for processing and interpreting geophysical data - demonstrate a fundamental understanding of economic risk assessment of exploration and production of resources in the Arctic - carry out independently: measurement, analysis, interpretation and data processing under condition of polar regions - have learned the decision making language based on scientific footing	
Contents	The module covers exploration of mineral and living resources in polar regions and methods of their sustainable exploitation including: - general risk assessment, land and leasing theory - basic geophysical methods used by exploration with processing and interpretation of geophysical and geological data - methods of hydrocarbon exploration and exploitation - methods of mineral exploration and exploitation - peculiarities of natural polar land and marine environments - sustainable use of living and non-living resources	
Educational concept	The module includes lectures, seminars and practical exercises: 4.1 Economic and social geography of the Arctic; L, S [S. Khruschev] CP 0.5 4.2 Living resources in the Arctic environment and their use; L, S [O. Galanina] CP 1.5 in correspondence with module 3 4.3 Mineral resources; L, S [G. Cherkashov] CP 1 4.4 Hydrocarbon resources; L, P, S, E [W.-Ch. Dullo] CP 3.5 4.5 Processing and analysis of geophysical data; L, P, S [V. Troyan, A. Dehghani] CP 2.5	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	Basics of geophysics, geology and ecology	
Grading framework (possibly including examinations)	Type:	1 written exam
	Requirements for registration for examination:	Participation in lectures, excursions, practical training and seminars is obligatory
	Language:	English
	Duration / size:	Max. 90 minutes
	Possibly weighted by the	Average grade of the courses

	credits for the module grade:	
Credits	9.0	
Workload	Campus study:	120 hours
	Self-study:	120 hours
	Exam preparation:	30 hours
Module Type	Compulsory	
Semester	Semester 2 of M.Sc. POMOR	
Frequency of offer	Every second year in summer semester	
Duration	1 semester	
Module usability	Compulsory for M.Sc. POMOR	
Module coordinator	W.-Ch. Dullo, V. Troyan	
Course lecturer(s)	G. Cherkashov, A. Dehghani, W.-Ch. Dullo, O. Galanina, S. Khrushchev, V. Troyan	
Literature	Jean-Pierre Favennec 2011: Oil and Gas Exploration and Production: Reserves, Costs, Contracts, Editions Technip. Flavio Poletto, Francesco Flügel, E., 2005: Microfacies of Limestones. Springer, 975 pp. Sheriff, R. E., 2010: Encyclopaedic dictionary of applied geophysics, 4th edition. Society of Exploration. Geophysics. Tulsa. Troyan, V., 2009: Inversion of geophysical problems, St. Petersburg, 184 pp. Troyan, V., Kiselev, Yu., 2010: Statistical methods of geophysical data processing, World Scientific, New Jersey, 436pp. Chernov Yu.I. 2008. Ecology and Biogeography. Selected works. M., KMK Scientific Press Ltd. 580 p. Daniëls F. J.A., Molenaar de J. G., Chytrý M., Tichý L., 2011.Vegetation change in Southeast Greenland Tasiilaq revisited after 40 years / Applied Vegetation Science. Volume 14, issue 2. P.230–241. Oiffer L., Siciliano S. D. 2009. Methyl mercury production and loss in Arctic soil. Journal: Science of The Total Environment - SCI TOTAL ENVIR , vol. 407, no. 5, pp. 1691-1700. http://www.sciencedirect.com/science/article/pii/S004896970801053X# Sydeman W. J., Thompson S. A., Kitaysky A. 2012. Seabirds and climate change: roadmap for the future. Marine Ecology Progress Series. Vol. 454. P.107–117. Huettmann F., Artukhin Yu., Gilg O. & Humphries G. 2011. Predictions of 27 Arctic pelagic seabird distributions using public environmental variables, assessed with colony data: a first digital IPY and GBIF open access synthesis platform. Marine Biodiversity. March 2011, Vol. 41, Issue 1. P. 141-179. Hansen, M. B., Scheck-Wenderoth, M., Hübscher, C., Lykke-Andersen H., Dehghani, A., Hell, B., Gajewski, D., 2007 Basin evolution of the northern part of the Northeast German Basin - insights from a 3D structural model. Tectonophysics 437 (1-4),	

	1 – 16 Specific literature and other sources will be announced during the courses

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Module 5 Processes in the Coastal Zone and Environmental Management

Symbol	CZEM
Title	Processes in the Coastal Zone and Environmental Management
Learning outcomes	After completing this module, students are expected to: - be able to understand and to review international regulations and frameworks relevant to marine and coastal zone management and current cooperation trends and developments - understand the basics in environmental management concepts and approaches, systems and processes, current trends - to understand principals of sustainable development and have obtained practical skills in methodology of industrial impact assessment for oil and gas extraction Arctic areas - be able to examine marine information systems as end-users, indicating objectives, components, variables; to formulate and to solve tasks using the marine information systems (MIS) - carry out independently: measurement, analysis, interpretation and data processing - understand and have obtained practical skills in basic geostatistics - have gained advanced knowledge of major coastal processes including natural and anthropogenic forcing of erosion and other sediments - develop monitoring strategies in coastal zones
Contents	Module covers a range of topics on coastal zone environment and coastal zone management using case studies: - basics in international environmental regimes and laws - environmental management concepts and approaches, their development - coastal zone indigenous communities and conflicts between traditional and industrial use of resources. Assessment of the industrial impact on local population - basics of MIS development. Studying several web-based MIS, presenting them to others - basics of the decision support process, data collection, criteria development and assessment, evaluation of uncertainty and risk in the decision making process. Practical realization of several tasks, using GIS tools to support decision making process - physical processes in coastal zones and engineering, modeling and data exploration in coastal geosciences - applied geostatistics: basic principles and methodology - coastal zones eutrophication, monitoring and assessment
Educational concept	8 courses include lectures with seminars and practical exercises: 5.1 Applied geostatistics; L, P [H. Burger] CP 0.5 5.2 Eutrophication, monitoring, assessment, coastal zone management; L, S [B. von Bodungen, M. Böttcher] CP 2 5.3 Marine environmental law; L, S [T. Markus, N. Alekseeva] CP 1.5 5.4 Numerical modelling of coastal processes; L, S [P. Fröhle] CP 1.5 5.5 Modern approaches towards environment management:

	co-management; L, S [N. Alekseeva] CP 0.5 5.6 Indigenous population and industrial development in Arctic areas: impact assessment and sustainable development strategies; L, S [K. Klokov] CP 1.5 5.7 Integrated water management systems for the Arctic and sub-arctic regions; L, S, P [E. Shalina] CP 0.5 5.8 Decision support tools and forecasting; L, P, S [E. Shalina] CP 1	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Basic skills in ecology, environmental management and GIS	
Grading framework (possibly including examinations)	Type:	1 written exam
	Requirements for registration for examination:	Participation in lectures, excursions, practical training and seminars is obligatory
	Language:	English
	Duration / size:	Max. 90 minutes
	Possibly weighted by the credits for the module grade:	Average grade of the courses
Credits	9.0	
Workload	Campus study:	120 hours
	Self-study:	120 hours
	Exam preparation:	30 hours
Module type	Compulsory	
Semester	Semester 2 of M.Sc. POMOR	
Frequency of offer	Every second year in summer semester	
Duration	1 semester	
Module usability	Semester 2 of M.Sc. POMOR	
Module coordinator	B. von Bodungen, K. Klokov	
Course lecturer(s)	N. Alekseeva, B. von Bodungen, M. Böttcher, H. Burger, P. Fröhle, K. Klokov, T. Markus, E. Shalina	
Literature	Alekseev, G. V., 1998: Arctic climate dynamics in the global environment. World Climatology Research Program, World Meteorological Org. Geneva (908), 11-14. Barbier, E.B. (ed.), 1993: Economics and ecology. New frontiers and sustainable development. Bass, S., 1993: Ecology and Economics in Small Islands: constructing a framework for sustainable development. Chapman & Hall, London, 205 pp. CEM, 2002: Coastal Engineering Manual. Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, Washington, D.C. (in 6 volumes) http://chl.erdc.usace.army.mil/CHL.aspx?p=s&a=PUBLICATIONS;8 Davis, J.C., 2002: Statistics and Data Analysis in Geology. Wiley, New York, 638 pp.	

	Drugov, Ju. S., 2000: Ecological analytical chemistry. Moscow, 434 pp. Kirchner, A. (ed.), 2003: International Marine Environmental Law. Kluwer Law International, The Hague, 268 pp. Sherman, K., Skjoldal, H. R. (eds.), 2002: Large Marine Ecosystems of the North Atlantic, Elsevier, Amsterdam. Specific literature will be given during the courses

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Module 6 Periglacial Environment

Symbol	PERIGLAC	
Title	Periglacial Environment	
Learning outcomes	Students - have gained advanced knowledge of the structure of periglacial environmental systems and effects of basic cryogenic processes, types and dynamics of ground ices, glaciers and water bodies - carry out independently: measurement, analysis, interpretation and data processing - can evaluate anthropogenic impacts on periglacial ecosystems - are able to evaluate the impact of global climate change on periglacial environment	
Contents	Introduction to periglacial environment as dominant in the polar regions: - basic cryogenic processes, cryogenic landforms, thermokarst formation and gas hydrate distribution - permafrost, its distribution and properties, active layer and cryosols - biochemical and microbiological processes in Arctic environment - water resources: river runoff and periglacial lake/swamp complexes, glaciers and ice caps - climate variability and its influence on periglacial environment, current trends in periglacial systems due to global warming - man-induced changes in periglacial ecosystems - natural disasters in polar regions	
Educational concept	4 courses include lectures with seminars, practical exercises and excursion: 6.1 Periglacial environment systems and climate change; L, S [K. Chistiakov, D. Ganushkin, H.-W. Hubberten, G. Menzhulin] CP 3 6.2 Glaciers and ice caps; L, S, P [K. Chistyakov, D. Ganushkin] CP 1 6.3 Cryogenic processes, cryosols, geochemical cycles in polar regions; L, S, E [C. Knoblauch, S. Lesovaya, E.-M. Pfeiffer] CP 3 6.4 Periglacial water bodies, river runoff and basic types of antropogenic influence on water bodies of polar land; L, S, P [I. Fedorova, T. Potapova, V. Vuglinsky, S. Zhuravlev] CP 2	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Basics in biology, hydrology and chemistry	
Grading framework (possibly including examinations)	Type:	1 written exam
	Requirements for registration for examination:	Participation in lectures, excursions, practical training and seminars is obligatory
	Language:	English

	Duration / size:	Max. 90 min
	Possibly weighted by the credits for the module grade:	Average grade of the courses
Credits	9.0	
Workload	Campus study:	120 hours
	Self-study:	120 hours
	Exam preparation:	30 hours
Module type	Compulsory	
Semester	Semester 2 of M.Sc. POMOR	
Frequency of offer	Every second year in the summer semester	
Duration	1 semester	
Module usability	Compulsory for M.Sc. POMOR	
Module coordinator	K. Chistyakov, H.-W. Hubberten, E.-M. Pfeiffer, V. Vuglinsky	
Course lecturer(s)	K. Chistyakov, I. Fedorova, D. Ganushkin, H.-W. Hubberten, C. Knoblauch, S. Lesovaya, G. Menzhulin, E.-M. Pfeiffer, T. Potapova, V. Vuglinsky, S. Zhuravlev	
Literature	French, H. M., 2010: The Periglacial Environment. Pearson Education, 762 pp. Hoefs, J., 2009: Stable Isotope Geochemistry, 4th Edition. Springer Berlin, 201 pp. Kimble, J.M. (ed.), 2004: Cryosols. Permafrost-Affected Soils. Springer Berlin. 726 pp. Lammers, R.B., Shiklomanov, A.I., Vorosmarty, C.J., Fekete, B.M., and Peterson, B.J., 2001: Assessment of contemporary arctic river runoff based on observational discharge records. Journal of Geophysical Research, 106 (3), 321-334. Magnuson, J., Robertson, D., Benson, B., Wynne, R., Living-stonk, D., Arai, T., Assel, R., Barry, R., Card, V., Kuusisto, E., Granin, N., Prowse, T., Steward, K., and Vuglinsky, V., 2000: Historical Trends in lake and river ice cover in the Northern Hemisphere. Science, 289 (1), 743-746. Yershov, E. D., 1998: General Geocryology. Cambridge University Press. Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Semester 3 – Winter Semester

Semester in Germany at the University of Hamburg or at the partner universities: University of Bremen, Christian Albrecht University of Kiel, University of Potsdam

Symbol	DS	
Title	Semester abroad at one of the partner universities in Germany	
Learning outcomes	Graduates are able to understand and to evaluate the complex marine and terrestrial Arctic systems concerning vulnerability and impact of climate changes	
Contents	Semester abroad at one of the partner universities in the following M.Sc. programs: - University of Hamburg: Integrated Climate System Sciences (M.Sc. ICSS) / Climate change, permafrost and polar systems - University of Bremen: M.Sc. Marine Biology / Marine biology in Arctic regions - Christian Albrecht University of Kiel: M.Sc. Marine Geosciences / Marine and polar geosciences - University of Potsdam: M.Sc. Geosciences/Geology / Geology with focus on periglacial environments Every partner M.Sc. offers the following module components: Specialization, Elective courses and Additionals in Geosciences.	
Educational concept	- DS 1: Specialization - DS 2: Elective courses - DS 3: Additionals L, S, P, E	
Language	English	
Formal requirements for participation	Successful completion of 60 CP of M.Sc. POMOR	
Recommended prerequisites	See specific requirements of the participating M.Sc. programs	
Grading framework (possibly including examinations)	Type:	3-5 exams
	Language:	English
Credits	30.0	
Workload	Campus study:	150 hours
	Self-study:	480 hours
	Exam preparation:	270 hours
Module type	Compulsory	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Compulsory for M.Sc. POMOR	
Coordinator	University of Hamburg: E.-M. Pfeiffer University of Bremen: H. Auel Christian Albrecht University of Kiel: W.-Ch. Dullo	

	University of Potsdam: H.-W. Hubberten
Course lecturer(s)	See extracts from module handbooks of the partner universities attached
Literature	See specific announcements for the individual courses

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

University of Hamburg

Symbol	**DS / University of Hamburg (UHH) - overview**	
Title	Semester abroad at the University of Hamburg	
Learning outcomes	The students solve research oriented problems and evaluate processes in the Arctic with focus on climate-related research questions. They communicate with colleagues from different disciplines and are able to generate, to interpret and to combine scientific results in the field of marine and polar sciences.	
Contents	Based on the modules of the M.Sc. ICSS students can choose different courses: DS 1 UHH: Specialization in Climate Change and Arctic Systems DS 2 UHH: Elective Courses in Climate Systems DS 3 UHH: Additionals in Climate Science	
Educational concept	L, S, P, E	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	Knowledge of mathematics and physics may be required. See module description and the specific announcements for the individual courses.	
Grading framework (possibly including examinations)	Type:	3-5 exams
	Language:	English
Credits	30.0	
Coordinator	E.-M. Pfeiffer	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E

Symbol	**DS 1 UHH**	
Title	Specialization in Climate Change and Arctic Systems	
Learning outcomes	The students have in-depth theoretical and practical expertise with different methods and can apply them for climate relevant questions in arctic systems.	
Contents	Recommended courses of the M.Sc. ICSS are: - Predictability and Predictions of Climate (CLIADD-5); L, S [J. Baehr] CP 3 - Permafrost Soils & Landscapes in the Climate System (CLI-ADD-9); L [L. Kutzbach, E.-M. Pfeiffer] CP 3 - Hydrochemical Modeling (CLIADD–11); L, P [J. Hartmann] CP 3 - Application of Stable Isotopes in Terrestrial Ecosystems (CLIADD–12); L, P [C. Knoblauch] CP 3	
Educational concept	L, S, P	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	Knowledge of mathematics and physics may be required. See module description and the specific announcements for the individual courses	
Grading framework (possibly including examinations)	Type:	Written exams, written reports, tests
	Language:	English
Credits	9.0-12.0	
Workload	Campus study:	50 hours
	Self-study:	160 hours
	Exam preparation:	90 hours
Module type	Elective	
Semester	Semester 3 of M.Sc. POMOR	
Frequencyofoffer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	E.-M. Pfeiffer	
Course lecturer(s)	Lecturers are listet in the extract from the module handbook of the M.Sc. ICCS attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 2 UHH**	
Title	Elective Courses in Climate Systems	
Learning outcomes	Students gained deeper and more specific understanding on different problems of arctic systems and are able to develop solutions.	
Contents	Recommended courses of the M.Sc. ICSS are: - Multivariate Research Methods (CLIADD – 15); L, S [S. Drobnič] CP 6 - European Corporate Governance (CLIADD – 16); L [A. Bassen, C. Zöllner] CP 3 - Climate and Environmental Change (CLISPEC–5); L [J. Böhner, U. Schickhoff] CP 3 - Chemistry of Natural Waters (CLISPEC–4); L, S [J. Hartmann] CP 3 - Introductory Course on Sustainability (CLISOC–2) L, P [U. Schneider] CP 3	
Educational concept	L, S, P	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	Knowledge of mathematics and physics may be required. See module description and the specific announcements for the individual courses	
Grading framework (possibly including examinations)	Type:	Written exams, written reports, tests
	Language:	English
Credits	9.0-12.0	
Workload	Campus study:	50 hours
	Self-study:	160 hours
	Exam preparation:	90 hours
Module type	Elective	
Semester	Semester 3 of M.Sc. POMOR	
Frequencyofoffer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	E.-M. Pfeiffer	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. ICCS attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 3 UHH**	
Title	Additionals in Climate Science	
Learning outcomes	The students can answer research oriented questions and evaluate processes in the geosciences with focus on climate change processes in the Arctic. The students can discuss with scientist from different disciplines and are able to combine their own scientific results of the polar regions with other fields in the geo sciences.	
Contents	Recommended courses of the M.Sc. ICSS are: - Global Biogeochemical Cycles and the Climate System (CLISYS–2); L, P [J. Hartmann, L. Kutzbach] CP 3 - Using the Eddy Covariance Method for Analyzing Land-Atmosphere Fluxes (CLIADD–8); S, P [L. Kutzbach, C. Wille] CP 3 - Sea Ice (CLISPEC – 2); L, P [L. Kaleschke] CP 3 - Terrestrial Ecosystem Processes within Earth System Models (CLIADD-13); L [V. Brovkin] CP 3	
Educational concept	L, S, P	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	Knowledge of mathematics and physics may be required. See module description and the specific announcements for the individual courses	
Grading framework (possibly including examinations)	Type:	Written exams, written reports, tests
	Requirements for registration for examination:	
	Language:	English
Credits	9.0-12.0	
Workload	Campus study:	50 hours
	Self-study:	160 hours
	Exam preparation:	90 hours
Module type	Elective	
Semester	Semester 3 of M.Sc. POMOR	
Frequencyofoffer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	E.-M. Pfeiffer	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. ICCS attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

University of Bremen

Symbol	**DS / University of Bremen - overview**	
Title	Semester abroad at the University of Bremen	
Learning outcomes	M.Sc. Program in Marine Biology utilizes both the expertise and the state-of-the-art research infrastructure for a progressive education of a new generation of marine scientists.	
Contents	Based on the modules of the M.Sc. Marine Biology students can choose the following courses: DS 1 UHB: Specialization: Student Research Project DS 2 UHB: Elective Courses DS 3 UHB: Research Grant Proposal	
Educational concept	L, S, P, E	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	3-5 exams
	Language:	English
Credits	30.0	
Coordinator	H. Auel	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 1 UHB**	
Title	Specialization: Student Research Project in Polar Marine Biology	
Learning outcomes	Students will learn how to carry out a scientific project, including state-of-the-art methodology, data analysis and report writing. The Student Research Project includes the same steps as the following master thesis project, albeit on a smaller scale. Students get into contact with modern methods and active research.	
Contents	POMOR students conduct a practical research project in the field of Polar Marine Biology integrated in a research team at the AWI or at Bremen University. Scientific content and methodologies will depend on the actual project topic	
Educational concept	S, P, E	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written project report
	Language:	English
Credits	12.0	
Workload	360 h	
Module type	Compulsory	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	H. Auel	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Marine Biology attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 2 UHB**	
Title	Elective Courses	
Learning outcomes	Students have gained theoretical background in marine biology and biological oceanography. They understand modern scientific concepts and get familiar with the research topics and facilities of these partner institutions, which all are actively involved in teaching at the University of Bremen. Students can write scientific publications, give excellent oral and poster presentations at conferences and have obtained German language skills	
Contents	- Principles of Marine Biology and Biological Oceanography; L, S [V. Smetacek]; CP 5 - Marine Research in Bremen; P, E [AWI, ZMT, MPI] CP 1 - Scientific Communication; L, S [D. Abele, A. Cembella] CP 3 - German language; L, S [Goethe Institute] CP 3	
Educational concept	L, S, P, E	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written exams, written reports, tests and oral presentations
	Language:	English
Credits	9.0	
Workload	270 h	
Module type	Elective for POMOR	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	H. Auel	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Marine Biology attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 3 UHB**	
Title	Additionals: Research Grant Proposal	
Learning outcomes	Students can prepare a grant proposal for a research project	
Contents	After a brief introduction on how to write a grant proposal for a research project, students prepare the grant proposal on the topic of their master theses	
Educational concept	S, P, E	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written grant proposal and oral defence of the grant proposal
	Language:	English
Credits	9.0	
Workload	270 h	
Module type	Elective for POMOR	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	H. Auel	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Marine Biology attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Christian Albrechts University of Kiel

Symbol	**DS / Christian Albrecht University of Kiel (CAU) - overview**	
Title	Semester abroad at the Christian Albrecht University of Kiel	
Learning outcomes	Students have obtained the latest state of marine geosciences and technology, in particular in marine geology, past climates, biogeochemistry and paleoecology; they know fundamental terms of geological, biological, geochemical and physical processes in the ocean. The students can create and critically assess scientific results and plan, carry out and evaluate ship and laboratory projects on their own responsibility.	
Contents	Based on the modules of the M.Sc. Marine Geosciences students can choose different courses: DS 1 CAU: Specialization: Marine Geosciences DS 2 CAU: Elective Courses DS 3 CAU: Additionals in Marine Geosciences	
Educational concept	L, S, P, E	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written exams
	Language:	English
Credits	30.0	
Coordinator	W.-Ch. Dullo	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 1 CAU**	
Title	Specialization: Marine Geosciences	
Learning outcomes	The students have acquired knowledge on marine hydrothermal and volcanic systems and their associated ore deposits and have obtained competence in professional economic geology and deep sea mining techniques. They understand isotope fractionation in stable, radiogenic, radioactive, traditional and non-traditional isotope systems.	
Contents	Recommended courses of the M.Sc. Marine Geosciences are: - Marine Geosystems (MNF-mgeo-MGS); L, S [A. Eisenhauer] CP 4 - Marine Resources (MNF-mgeo-MR); L [C. Devey] CP 3 - Basin Analysis (MNF-geow-MP3); L [W.-Ch. Dullo] CP 5	
Educational concept	L, S	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written exams
	Language:	English
Credits	9.0-12.0	
Workload	Campus study:	50 hours
	Self-study:	160 hours
	Exam preparation:	90 hours
Module type	Compulsory	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	W.-Ch. Dullo	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Marine Geosciences attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 2 CAU**	
Title	Elective Courses	
Learning outcomes	The students have obtained well-grounded knowledge of isotope geochemistry and geochronology. They can analyze sedimentary structures, and reconstruct sediment-dynamic processes applied to the coastal zone of Schleswig-Holstein. The students can carry out independent analytical data acquisition and validation.	
Contents	Recommended courses of the M.Sc. Marine Geosciences are: - Petrology/Geochemistry (MNF-geow-MP5); P, L, S [K. Hoernle] CP 5 - Coastal Geology (MNF-mgeo-MP2); L, S [K. Schwarzer] CP 5 - Project Work Marine Geosciences (MNF-mgeo-WP); S, P [R. Schneider] CP 10 - German Course I; S CP 6	
Educational concept	L, S, P	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written exams
	Language:	English
Credits	9.0-12.0	
Workload	Campus study:	50 hours
	Self-study:	160 hours
	Exam preparation:	90 hours
Module type	Compulsory	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	W.-Ch. Dullo	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Marine Geosciences attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 3 CAU**	
Title	Additionals in Marine Geosciences	
Learning outcomes	The students understand complex biogeochemical fluxes in the ocean and marine environmental change in Earth´s History. They have obtained knowledge of state of the art chemical laboratory techniques applied to marine sediments. The can critically examine innovative topics of paleontological research.	
Contents	Recommended courses of the M.Sc. Marine Geosciences are: - Biogeochemistry (MNF-geow-MP4); L, P [K. Wallmann] CP 5 - Chemical Paleoceanography (MNF-mgeo-CP); L, S [M. Frank] CP 4 - Evolution of Biosphere and Climate (MNF-mgeo-MP1); L [P. Schäfer] CP 4	
Educational concept	L, S, P	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written exams
	Language:	English
Credits	9.0-12.0	
Workload	Campus study:	50 hours
	Self-study:	160 hours
	Exam preparation:	90 hours
Module type	Compulsory	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	W.-Ch. Dullo	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Marine Geosciences attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

University of Potsdam

Symbol	**DS / University of Potsdam - overview**	
Title	Semester abroad at University of Potsdam	
Learning outcomes	The students understand environmental processes and driving forces of the climate system through earth history. They have obtained advanced knowledge in geosciences with focus on permafrost and geology.	
Contents	Based on the modules of the M.Sc. Geosciences/Geology students can choose different courses: DS 1 UP: Specialization: Permafrost and Palaeoclimate DS 2 UP: Elective courses: Topics in Geosciences DS 3 UP: Additionals: Internship at the AWI	
Educational concept	L, S, P, E	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	3-5 exams
	Language:	English
Credits	30.0	
Coordinator	H.-W. Hubberten	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 1 UP**	
Title	Specialization: Permafrost and Paleoclimate	
Learning outcomes	The students understand the principles of formation and the characteristics of permafrost and the formation and degradation of periglacial landscapes. They have studied environmental processes and driving forces of the climate system through earth history.	
Contents	Recommended courses of the M.Sc. Geosciences/Geology are: - Permafrost landscapes (MGEW15); L, S, P [H.-W. Hubberten] CP 6 - Paleoclimate dynamics (MGEW13); L, P [B. Dieckmann, M. Trauth] CP 6	
Educational concept	L, S, P	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written exam
	Language:	English
Credits	6.0-12.0	
Workload	Campus study:	50 hours
	Self-study:	160 hours
	Exam preparation:	90 hours
Module type	Elective	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	H.-W. Hubberten	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Geosciences/Geology attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 2 UP**	
Title	Elective courses: Topics in Geosciences	
Learning outcomes	Students have acquired in-depth knowledge of the methods of basin analysis and petroleum systems. Students understand the impact of the events in Earth history on the climate change	
Contents	Recommended courses of the M.Sc. Geosciences/Geology are: - Sedimentary Basins (MGEP05); L, S, P [M. Mutti] CP 6 - Petroleum Geology (MGEW03); L, S, P [G. Frija] CP 6 - Events in Earth History (MGEW04); L, S, P [M. Szurlies] CP 6	
Educational concept	L,S, P	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written and oral exams, seminar talks
	Language:	English
Credits	6.0-12.0	
Workload	Campus study:	50 hours
	Self-study:	160 hours
	Exam preparation:	90 hours
Module type	Elective	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	H.-W. Hubberten	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Geosciences/Geology attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Symbol	**DS 3 UP**	
Title	Additionals: Internship at the AWI	
Learning outcomes	The students have obtained practical knowledge and skills in selected areas of geosciences	
Contents	Internship at the AWI	
Educational concept	S, P, E	
Language	English	
Formal requirements for participation	None	
Recommended prerequisites	None	
Grading framework (possibly including examinations)	Type:	Written report
	Language:	English
Credits	12.0	
Workload	360 h	
Module type	Elective	
Semester	Semester 3 of M.Sc. POMOR	
Frequency of offer	Every second year in winter semester	
Duration	1 semester	
Usability	Elective for M.Sc. POMOR	
Coordinator	H.-W. Hubberten	
Course lecturer(s)	See an extract from the module handbook of the M.Sc. Geosciences/Geology attached	
Literature	Specific literature will be announced during the courses	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion E.

Semester 4 – Summer Semester

M.Sc. Thesis

Symbol	POMORTHESIS	
Title	M.Sc. Thesis “Polar and Marine Sciences”	
Learning outcomes	The graduates demonstrate the ability to elaborate and to present an innovative M.Sc. thesis in a specific field of applied polar and marine sciences	
Contents	The student will carry out an in-depth study of a chosen topic in applied polar and marine sciences under the co-supervision of scientists and lecturers within the POMOR network in Russia and Germany. The study will involve a critical review of the topic and/or the original research, will show the significance of the chosen topic for applied polar and marine sciences and lead to an extended master thesis. The master thesis is embedded in an on-going research project.	
Educational concept	Practical work, writing the master thesis and oral presentation of the master thesis	
Language	English	
Formal requirements for participation	Completion of 60 CP of the M.Sc. POMOR	
Recommended Prerequisites	None	
Grading framework (possibly including examinations)	Type:	M.Sc. thesis and oral presentation
	Requirements for registration for examination:	None
	Language:	English
	Duration / size:	
	Possibly weighted by the credits for the module grade:	Thesis 80% and oral presentation including discussion 20%
Credits	30.0	
Workload	Campus study:	
	Self-study:	22 weeks
	Exam preparation:	
Course type	Compulsory	
Semester	Semester 4 of M.Sc. POMOR	
Frequencyofoffer	Every second year in summer semester	
Duration	1 Semester	
Usability	Compulsory	
Coordinator	G. Cherkashov, E.-M. Pfeiffer, J. Thiede	
Lecturer(s)	All advisors	

Abbreviations: Lecture L. Practical training P. Seminar S. Excursion.

Universität Hamburg

Fakultät für Mathematik, Informatik und Naturwissenschaften – Department Geowissenschaften

EXTRACTS
from the module handbooks
of the partner M.Sc. programs

- M.Sc. Integrated Climate System Sciences (University of Hamburg)
- M.Sc. Marine Biology (University of Bremen)
- M.Sc. Marine Geosciences (Christian Albrechts University of Kiel)
- M.Sc. Geosciences/Geology (University of Potsdam)

Content

University of Hamburg

Extract from the module handbook of the M.Sc. Integrated Climate System Sciences

DS 1 UHH: Specialization

Course Abbreviation	CLIADD - 5	
Title	Predictability and Predictions of Climate	
Learning outcomes	Students will be familiar with the techniques used to investigate predictability and the methods used to make predictions of climate variability at seasonal to decadal timescales with a focus on coupled ocean-atmosphere processes.	
Contents	Introduction to predictability of climate; Lorenz model; determination of predictability; ensemble forecasting; forecast initialization; ensemble initialization; error propagation and assessment of forecast reliability/quality; present understanding of the processes that determine predictability; seasonal to decadal predictions of the climate system.	
Educational concept	Lectures and research seminar (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	None	
Grading framework (possibly including examinations)	Type:	The type of examination will be announced during registration for or at the beginning of the course
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	
Credits	3.0	
Workload	Campus study:	28 hours
	Self-study:	32 hours
	Exam preparation:	30 hours
Course type	Elective	
Semester	Semester 3 of M.Sc. ICSS	
Frequency of offer	Every other year in the winter semester, alternating with course 3.3.5 „Ocean Data Assimilation”	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs,dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	J. Baehr	
Literature	Predictability of weather and climate, Palmer & Hagedorn (Eds.), 2006. Additional literature will be announced during the course	

Course Abbreviation	CLIADD - 9	
Title	Permafrost Soils and Landscapes in the Climate System	
Learning outcomes	Students have gained knowledge about permafrost landscapes, soils and vegetation and their role in the climate system. A focus will be set on periglacial and cryopedogenetic processes. The students improve their understanding of environmental and climatic changes in arctic region. They obtain competence for the evaluation of ecosystem functions and resources of permafrost landscapes.	
Contents	High-latitude terrestrial processes in periglacial landscapes; permafrost and active layer processes; soils of different permafrost landscapes; cryosols in the international soil classifications; patterned-ground processes, frost-action processes, cryoturbation; tundra vegetation, boreal forests and peatlands, tree- and shrubline dynamics; carbon in permafrost soils and sediments; role of high-latitude terrestrial systems in the global climate system; impact of climate and land use change on arctic and boreal ecosystems and permafrost; observational versus model results of permafrost changes due to climate change.	
Educational concept	Lectures (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Basic knowledge of soil science	
Grading framework (possibly including examinations)	Type:	Written examination
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	60 minutes
	Weight factor for module grade (if applicable):	
Credits	3.0	
Workload	Campus study:	28 hours
	Self-study:	36 hours
	Exam preparation:	26 hours
Course type	Elective	
Semester	Semester 3 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs,dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	E.-M. Pfeiffer, L. Kutzbach	
Literature	Arctic Climate Impact Assessment (ACIA) (2005): ACIA Scientific report. Cambridge University Press. French, H. M. (1996): The Periglacial Environment. Pearson Education. Washburn, A. L. (1979): Geocryology. A Survey of Periglacial Processes and Environments. Arnold.	

Course Abbreviation	CLIADD - 11	
Title	Hydrochemical Modeling	
Learning outcomes	Students can apply hydrogeochemical models to analyse natural as well as manmade impacts on the compoistion of natural waters. Students are capable to model mineral dissolution processes, to identify equilibrium conditions of an aquatic system. They know how to use hydrochemical modeling software to analyse climate relevant matter in the water system (e.g. CO_2).	
Contents	Theory of hydrochemical equilibrium models and application of PHEEQC to solve scientific questions related to the climate system. This includes determination of saturation indices, adjustment of equilibria/disequilibria for minerals and gases, mixing of waters (for example in the coastal zone), modeling the effect of temperature on hydrochemical reactions, reactions in open and closed systems, calculation of the partial pressure of climate relevant gases in natural waters, discussion of case studies.	
Educational concept	Lectures and case study calculations (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Successful completion of the course “Chemistry of Natural Waters”(1.4.4) or comparable knowledge of the geochemistry of natural waters.	
Grading framework (possibly including examinations)	Type:	The type of examination will be announced during registration for or at the beginning of the course
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	
Credits	3.0	
Workload	Campus study:	28 hours
	Self-study:	40 hours
	Exam preparation:	22 hours
Course type	Elective	
Semester	Semester 3 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs,dependent on capacities and schedule. Maximum number of participants: 10; preference for ICSS students	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	J. Hartmann	
Literature	Will be announced during the course	

Course Abbreviation	CLIADD - 12	
Title	Application of Stable Isotopes in Terrestrial Ecosystems	
Learning outcomes	Students will be familiar with the potentials of stable isotope measurements for studying element fluxes in the terrestrial ecosystem. They will be able to interpret natural carbon isotope signatures in soils, vegetation and the climate relevant trace gases CO_2 and methane. Furthermore, they will be able to use ^{13}C- tracers for quantifying carbon turnover of different carbon pools in the environment.	
Contents	Introduction to the fundamentals of stable isotope biogeochemistry. Laboratory experiments for quantifying carbon fluxes in the environment, based on natural abundance measurements and isotope tracers. Calculation of CO_2 and methane-fluxes from different carbon pools.	
Educational concept	Practical laboratory course complemented by introductory lectures and exercises on data analysis (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Fundamental biogeochemical knowledge	
Grading framework (possibly including examinations)	Type:	The type of examination will be announced during registration for or at the beginning of the course
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	
Credits	3.0	
Workload	Campus study:	28 hours
	Self-study:	47 hours
	Exam preparation:	15 hours
Course type	Elective	
Semester	Semester 3 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs,dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	C. Knoblauch	
Literature	Sharp, Z., 2007. Principles of stable isotope geochemistry. Pearson Prentice Hall, Upper Saddle River. Hoefs, J. (2008). Stable isotope geochemistry. Springer, Berlin. Further literature will be announced during the course	

DS 2 UHH: Elective courses

Course Abbreviation	CLIADD - 15	
Title	Multivariate Research Methods	
Learning outcomes	Students have(1) awareness of various methods in design and analysis of various social science problems; (2) knowledge of methods and techniques for analyzing quantitative data; (3) skills necessary to critically evaluate published work in social sciences; (4) skills in modeling and carrying out their own research; (5) knowledge to interpret results of statistical analyses; (6) the basis for advanced courses in statistical methods	
Contents	This course provides an introduction to the logic of statistical control and multivariate statistical models, as they are commonly applied in the social science disciplines. Topics will include, among others, multivariate ordinary least squares regression, logistic regression, factor analysis, ANOVA, cluster analysis, time series.	
Educational concept	Lectures (4 SWS) with seminar-type discussions (elective participation in weekly computer lab sessions of 2 SWS in which students will learn through hands-on experience to analyze data and interpret their results)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Students are expected to have a solid command of the basic social science methodology and statistics, including inferential statistics and familiarity with SPSS (or some other large statistical package).	
Grading framework (possibly including examinations)	Type:	Written exam
	Requirements for registration for examination:	
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	
Credits	6.0	
Workload	Campus study:	56 hours
	Self-study:	88 hours
	Exam preparation:	36 hours
Course type	Elective	
Semester	Semester 3 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs,dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	S. Drobnič	
Literature	Agresti, Alan and Barbara Finley (4th edition): „Statistical Methods for the Social Sciences," Upper Saddle River, NJ: Prentice Hall.	

Course Abbreviation	CLIADD – 16	
Title	European Corporate Governance	
Learning outcomes	Students have obtained an overview of the various perspectives of and the trends in Corporate Governance in Europe, covering one of the most intensively discussed topics in finance and management today.	
Contents	The course develops a common understanding of Corporate Governance from a financial perspective, as well as its mechanisms and current regulatory reforms. It comprises among others the following topics: • Corporate Governance Around the World – Theory and Practice • Mechanisms of Corporate Governance • Convergence and Divergence of Transatlantic Corporate Governance	
Educational concept	Topics will be covered in lecturing and have to be interpreted in presentations (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Basic knowledge in financial and new institutional theory	
Grading framework (possibly including examinations)	Type:	Marks will be given upon the presentation (outline and slides to be handed in) and an oral examination covering all topics of the course
	Requirements for registration for examination:	
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	
Credits	3.0	
Workload	Campus study:	28 hours
	Self-study:	42 hours
	Exam preparation:	20 hours
Course type	Elective	
Semester	Semester 3 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs,dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	A. Bassen, C. Zöllner	
Literature	Will be announced during the course	

Course Abbreviation	CLISPEC – 5	
Title	Climate and Environmental Change	
Learning outcomes	Students know the fundamentals of climate system dynamics and factors affecting climate change in present, past and future, they have in-depth insights in climate and human-induced environmental changes and pressures on environmental resources, ecosystem functions and services.	
Contents	Introduction of basic physical processes causing fluctuations in the Earth's climate; brief recapitulation of the evolution of the Earth's climate system and climate history; impact of climate change on environmental resources (soil, water, vegetation); interdependencies of climate and human induced degradation processes and deterioration of ecosystem functions and services (focus: human impact on world vegetation); scenario based projections of future climate and environmental change; climate change adaptation and mitigation strategies.	
Educational concept	Lectures (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	None	
Grading framework (possibly including examinations)	Type:	The type of examination will be announced during registration for or at the beginning of the course
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	50%
Credits	3.0	
Workload	Campus study:	26 hours
	Self-study:	34 hours
	Exam preparation:	30 hours
Course Type	Elective	
Semester	Semester 1 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs, dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	J. Böhner, U. Schickhoff	
Literature	Will be announced during the course	

Course Abbreviation	CLISPEC – 4	
Title	Chemistry of Natural Waters	
Learning outcomes	Students know about important processes that control the chemical composition of natural waters (surface waters and groundwaters).	
Contents	Basic hydrochemical background knowledge, including equilibrium thermodynamics, activity-concentration relationships, the carboante system and pH control on the composition of waters, basic knowledge about clay minerals and cation exchange, organic compounds in natural waters, redox equilibria, redox conditions in natural waters, kinetics, weathering and water chemistry.The approach is to combine background theory (e.g. thermodynamics, carbonate system (CO_2), dissolution/precipitation of matter, physics of water-air gas exchange, etc.) with case studies from the literature.	
Educational concept	Lectures (2SWS). Discussion of representative examples	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Good knowledge of natural sciences.	
Grading framework (possibly including examinations)	Type:	The type of examination will be announced during registration for or at the beginning of the course
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	50%
Credits	3.0	
Workload	Campus study:	26 hours
	Self-study:	42 hours
	Exam preparation:	22 hours
Course Type	Elective	
Semester	Semester 1 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs, dependent on capacities and schedule. Maximum number of participants: 25; preference for ICSS students	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	J. Hartmann	
Literature	Will be announced during the course	

Course Abbreviation	CLISOC–2	
Title	Introductory Course on Sustainability	
Learning outcomes	Students have learned the theoretical foundations of sustainability.	
Contents	Definition, evolution, and classification of sustainability; Interferences with efficiency and equity; Posteriority and time preferences; Lessons from the past; Welfare and environmental economics; Externalities and public goods; Sustainability in actual policy making	
Educational concept	Lectures, practicals (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	None	
Grading framework (possibly including examinations)	Type:	
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	
Credits	3.0	
Workload	Campus study:	26 hours
	Self-study:	34 hours
	Exam preparation:	30 hours
Course Type	Compulsory	
Semester	Semester 1 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Compulsory for M.Sc.ICSS; open for students of related M.Sc. programs, dependent on capacities and schedule	
Module coordinator(s)	H. Held	
Course lecturer(s)	U. Schneider	
Literature	Will be announced during the course	

DS 3 UHH: Additionals in Climate Science

Course Abbreviation	CLISYS - 2	
Title	Global Biogeochemical Cycles and the Climate System	
Learning outcomes	Students understand the processes controlling the major global cycles of biogeochemical matter between the atmosphere, ocean and land. The students know the interactions between biogeochemical processes and the climate system.	
Contents	Biogeochemical processesrelevant on the global scale. This includes the explanation of hydrologic, atmospheric, extraterrestrial, geological, biological, and human causes environmental change on time scales of tens, thousands, and millions of years.	
Educational concept	Lectures and exercises (3 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	None	
Grading framework (possibly including examinations)	Type:	Joint module examination
	Requirements for registration for examination:	Successful completion of exercises handed out in class
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	
Credits	3	
Workload	Campus study:	32 hours
	Self-study:	32 hours
	Exam preparation:	26 hours
Course Type	Compulsory	
Semester	Semester 1 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Compulsory for M.Sc.ICSS; open for students of related M.Sc. programs, dependent on capacities and schedule. Maximum number of participants: 30 with preference for ICSS students	
Module coordinator(s)	C. Eden, M. Hort	
Course lecturer(s)	J. Hartmann, L. Kutzbach	
Literature	Will be announced during the course	

Course Abbreviation	CLIADD - 8	
Title	Using the Eddy Covariance Method for Analyzing Land-Atmosphere Fluxes	
Learning outcomes	Studentshavegained knowledge about the theoretical basics of the micrometeorological eddy covariance approach. They have learned how an eddy covariance flux measurement system is set-up and maintained, and how the data is recorded. They will be able to handle and process the complex and massive rawdata streams to derive the energy and matter fluxes. They obtain competence to apply the micrometeorological eddy covariance approach for the analysis of soil-vegetation-atmosphere fluxes of energy, water and carbon on the landscape scale.	
Contents	Introduction into the micrometeorological theory of the eddy covariance approach; requirements for instrumentation and measurement site; set-up and maintenance of an eddy covariance flux measurement system; introduction into the flux calculation software EdiRe; basic flux calculation from rawdata streams; flux corrections; data visualisation; quality control; application of eddy covariance data for the investigation of land-atmosphere exchange fluxes of energy, water and carbon.	
Educational concept	Combination of seminar (1 SWS), exercises (1 SWS) including a field trip	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	Basic knowledge of boundary layer meteorology	
Grading framework (possibly including examinations)	Type:	Written report about performed work
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	4 pages
	Weight factor for module grade (if applicable):	
Credits	3.0	
Workload	Campus study:	28 hours
	Self-study:	36 hours
	Exam preparation:	26 hours
Course type	Elective	
Semester	Semester 3 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs,dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	L. Kutzbach, C. Wille	
Literature	Foken, T. (2008): Micrometeorology. Springer, Berlin. Lee, X., Massmann, W., and Law, B. (eds.) (2004): Handbook of micrometeorology : a guide for surface flux measurement and analysis. Kluwer, Dordrecht [u.a.]. Stull, R. B. (2003): An Introduction to Boundary Layer Meteorology. Kluwer, Dordrecht	

Course Abbreviation	CLISPEC - 2	
Title	Sea Ice	
Learning outcomes	Students know the physical basics of sea ice and about the role of sea ice in the climate system.	
Contents	Sea ice phenomenology and nomenclature; sea ice phase diagram; growth and melt of sea ice; surface heat balance; interaction with the ocean and the atmosphere; electromagnetic properties; measurement techniques; sea ice climatology.	
Educational concept	Lectures and practical training (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	None	
Grading framework (possibly including examinations)	Type:	The type of examination will be announced during registration for or at the beginning of the course
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	50%
Credits	3.0	
Workload	Campus study:	26 hours
	Self-study:	34 hours
	Exam preparation:	30 hours
Course Type	Elective	
Semester	Semester 1 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs, dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	L. Kaleschke	
Literature	Will be announced during the course	

Course Abbreviation	CLIADD - 13	
Title	Terrestrial Ecosystem Processes within Earth System Models	
Learning outcomes	Students have theoretical knowledge and practical skills in terrestrial ecosystem modeling and feedbacks between vegetation and climate and understand and are able to utilize terrestrial biosphere models used for future climate projections.	
Contents	Introduction into models for large-scale vegetation dynamics. Explanation of basic structure of land carbon cycle models used on a global scale. Examples of modeling of landuse effects on terrestrial ecosystem and biogeochemistry, modeling of vegetation dynamics under changed climate; assessment of feedbacks between terrestrial ecosystems and climate on multiple spatial and scales. Biogeophysical and biogeochemical effects of land cover and landuse change on projected atmospheric CO_2 concentration and climate change.	
Educational concept	Lectures (2 SWS)	
Language	English	
Formal requirements for participation	None	
Recommended Prerequisites	None	
Grading framework (possibly including examinations)	Type:	The type of examination will be announced during registration for or at the beginning of the course
	Requirements for registration for examination:	Active participation
	Language:	English
	Duration / size:	
	Weight factor for module grade (if applicable):	
Credits	3.0	
Workload	Campus study:	28 hours
	Self-study:	46 hours
	Exam preparation:	16 hours
Course Type	Elective	
Semester	Semester 3 of M.Sc. ICSS	
Frequency of offer	Annually in the winter semester	
Duration	1 semester	
Course usability	Elective for M.Sc.ICSS; open for students of related M.Sc. programs,dependent on capacities and schedule	
Module coordinator(s)	C. Eden, M. Hort, H. Held	
Course lecturer(s)	V. Brovkin	
Literature	Will be announced during the course	

University of Bremen

Extract from the module handbook of the M.Sc. Marine Biology

DS 1 UHB: Specialization

Course name and specifications	• Course name: Student Research Project: Polar Marine Biology • Institute offering the course: University of Bremen • Semester: 3 • ECTS: 12
Teachers involved	Research scientists at the University of Bremen and at the Alfred Wegener Institute for Polar and Marine Research
Key words	Student Research Project
Objectives of the course	Student research project of 5 to 6 weeks duration in one of the research teams at AWI or at Bremen University: POMOR students conduct a practical research project in the field of Polar Marine Biology integrated in a research team. Topics on offer will vary from year to year, depending on ongoing research programmes. Students will learn how to carry out a scientific project, including state-of-the-art methodology, data analysis and report writing. The Student Research Project includes the same steps as the following master thesis project, albeit on a smaller scale. Students get into contact with modern methods and active research.
Content of the course	Student research project of 5 to 6 weeks duration in one of the research teams at AWI or at Bremen University: Scientific content and methodologies will depend on the actual project topic.
Teaching methods	• Lab work: 5 to 6 weeks
Examination	Written project report with a structure similar to a scientific publication

DS 2 UHB: Elective courses

Course name and specifications	• Course name: Principles of Marine Biology and Biological Oceanography • Institute offering the course: University of Bremen • Semester: 3 • Total amount of contact hours for the full course: 55 hours • ECTS: 5
Teachers involved	Victor Smetacek
Key words	Marine Biology, Biological Oceanography
Objectives of the course	The course provides the theoretical background in marine biology and biological oceanography. Modern scientific concepts are presented and the role of the oceans in the earth system is explained. Although POMOR students already receive training in Marine Biology during their first year in St. Petersburg (i.e. Module 3), they are a very diverse group of students with divergent qualifications due to the interdisciplinary nature of the POMOR programme and the students' different academic backgrounds. This course at the start of the study period at Bremen University provides sufficient background knowledge on marine biological and ecological concepts to those POMOR students, who intend to intensify their qualifications in the field of Marine Biology/Biological Oceanography, to enable them to carry out the practical work of the following Student Research Project.
Content of the course	Marine ecological processes; ecology of important taxa of marine organisms; influence of abiotic factors on biological processes; the ocean's role in biogeochemical processes.
Teaching methods	• Lectures: 40 hours • Seminars: 15 hours
Reading	Lalli & Parsons: Biological oceanography: an introduction. Nybakken: Marine biology: an ecological approach. Levinton: Marine biology: function, biodiversity, ecology. Kaiser et al.: Marine ecology: processes, systems, and impacts.
Examination	Written exam at the end of the course

Course name and specifications	• Course name: Marine Research in Bremen • Institute offering the course: University of Bremen • Semester: 3 • Total amount of contact hours for the full course: 20 hours • ECTS: 1
Teachers involved	Lecturers at AWI, ZMT, and MPI
Key words	Marine Research in Bremen, Alfred Wegener Institute for Polar and Marine Research (AWI), Leibniz Centre for Tropical Marine Ecology (ZMT), Max Planck Institute for Marine Microbiology (MPI)
Objectives of the course	The course Marine Research in Bremen includes day-tours to the associated marine research institutions in the Federal State of Bremen, i.e. the Alfred Wegener Institute for Polar and Marine Research (AWI), the Leibniz Centre for Tropical Marine Ecology (ZMT), and the Max Planck Institute for Marine Microbiology (MPI). Students will get familiar with the research topics and facilities of these partner institutions, which all are actively involved in teaching at the University of Bremen.
Content of the course	See objectives
Teaching methods	• Day excursions: 20 hours

Course name and specifications	• Course name: Scientific Communication • Institute offering the course: University of Bremen • Semester: 3 • Total amount of contact hours for the full course: 30 hours • ECTS: 3
Teachers involved	Doris Abele (course responsible) Allan Cembella (course responsible)
Key words	
Objectives of the course	Students will learn how to write scientific publications, how to give excellent oral and poster presentations at conferences.
Content of the course	Scientific Communication: Structure and preparation of scientific publications (journal publications, book chapters, M.Sc. theses, dissertations); Structure and presentation techniques of scientific talks at conferences, in seminars and during the defence of the own M.Sc. thesis.
Teaching methods	• Lectures: 20 hours • Seminars: 10 hours
Final competences	Scientific Communication: Understanding of the principles of communication, training of fundamental competences for a succesful communication through different media and towards different audiences: - role of visualisation in communication - diagrammes: structure and layout - posters: design, structure and layout - scientific writing - scientific talks and presentations
Examination	Student presentation of seminar topic

Course name and specifications	• German language training • Institute offering the course: University of Bremen • Semester: 3 • Total amount of contact hours for the full course: 40 • ECTS: 3
Teachers involved	Goethe Institute Bremen and Foreign Language Teaching Centre Bremen
Key words	German language training for international students
Objectives of the course	To learn German
Content of the course	German language training at an appropriate level depending on the actual current language skills of the respective student
Teaching methods	• Lectures: 20 hours • Seminars: 10 hours
Initial competences	Initial German language competences will be established by means of a placement test before the start of the course. Separate courses will be offered at different levels.
Final competences	Depending on the initial competences and the level of the actual course taken, either A1 or higher

DS 3 UHB: Grant Research Proposal

Course name and specifications	• Course name: Research Grant Proposal and Defence • Institute offering the course: University of Bremen • Semester: 3 • ECTS: 9
Teachers involved	Prospective supervisors of the master thesis Lecturers at the University of Bremen
Key words	grant proposal
Objectives of the course	Students will learn how to prepare a grant proposal for a research project. The topic will be based on the actual master thesis topic, and grant proposals shall be written according to the guidelines of DFG (German National Science Foundation). Besides learning about the procedures of project application, this course provides students with four to five weeks prior to the official start of the master thesis so that they have time to plan their thesis work, read about and summarize the current state-of-the-art, learn about suitable methods, develop research questions and hypotheses as well as prepare a work plan. Thus, they can directly start with practical work for their master theses, once this course is finished. Particularly in the case of POMOR students, who only have limited time available for the master thesis, split between St. Petersburg and Germany, it is essential that they do not lose time for preparatory work, which can be easily covered in the framework of this course.
Content of the course	After a brief introduction on how to write a grant proposal for a research project, students have 4 to 5 weeks time (usually after the Christmas break) to prepare the grant proposal on the topic of their master theses.
Learning material	Guidelines by DFG (German National Science Foundation) on how to prepare grant proposals for research projects.
Examination	Written grant proposal and oral defence of the grant proposal.

Christian Albrechts University of Kiel

Extract from the module handbook of the M.Sc. Marine Geosciences

DS 1 CAU: Specialization

Module title	Marine Geosystems
Module number	MNF-mgeo-MGS
Semester / duration	1 / 2 semesters
Coordinator	Prof. Dr. A. Eisenhauer
Courses	Marine Isotope Systems (L) Prof. Dr. Anton Eisenhauer Marine Geosystems (S) Prof. Dr. Anton Eisenhauer Prof. Dr. Martin Frank Prof. Dr. Ing. Klaus Wallmann
Workload	120 h
Credits	4
Requirements	BSc Geosciences
Learning outcomes	Process oriented understanding of isotope fractionation in stable, radiogenic, radioactive, traditional and non-traditional Isotope systems.
Contents	Marine Geosystems introduces physical, chemical and biological processes that lead to the transfer of elements (macro and trace), fluids (porewater, groundwater) and gases (methane, carbon dioxide) between the continents, marine sediments and seawater.These processes contribute to the delivery of chemical signatures to the geological record on all timescales. Modern technologies, e.g. the lander technology, porewater geochemistry and the analysis of stable, radiogenic and radioactive isotopes will be introduced.
Examination	Written exam covering the lectures
Literature	G. Faure, Principles of Isotope Geology A.P. Dickin, Radiogenic Isotope Geology; Geochemistry of Non-traditional Stable Isotopes
Further details	n.a.

Module title	Marine Resources
Module number	MNF-mgeo-MR
Semester / duration	1 / 2 semesters
Coordinator	Prof. Dr. C. Devey
Courses	Hydrothermal Systems and Ore Deposits (L) Prof. Dr. Colin Devey
Workload	90 h
Credits	3
Requirements	BSc Geosciences
Learning outcomes	The students will acquire knowledge on marine hydrothermal and volcanic systems and their associated ore deposits. Competence in professional economic geology and deep sea mining techniques.
Contents	Formation of marine ressources in association with volcanic, sedimentary and hydrothermal processes at the sea floor. Characterization of volcanic deposits and their eruption and transport mechanisms. Chemistry and petrology of hydrothermal precipitates, massive sulfides and altered rocks. Technologies for deep-sea exploration and exploitation.
Examination	Written exam
Literature	Hekinian, R., Stoffers, P., Cheminee, J.-L.: Oceanic Hotspots. Springer-Verlag Berlin, 253-280. 2004 P.E. Halbach, V. Tunnicliffe, and J.R. Hein: Energy and mass transfer in marine hydrothermal systems.Dahlem University Press, Berlin. Geochemistry of Hydrothermal Ore Deposits, 3rd Edition. Hubert Lloyd Barnes (Editor). ISBN: 978-0-471-57144-5. Hardcover. 992 pages. June 1997
Further details	n.a.

Module title	Basin Analysis
Module number	MNF-mgeo-MP3
Semester / duration	1 / 2 semesters
Coordinator	Prof. Dr. W.-Ch. Dullo
Courses	Sequence Stratigraphy and Facies Analysis (L) Prof. Dr. Wolf-Christian Dullo Petroleum Geology (L) Prof. Dr. Wolf-Christian Dullo
Workload	150 h
Credits	5
Requirements	BSc Geosciences
Learning outcomes	Students will acquire knowledge in the facies and stratigraphic analysis of basin depositional systems and their interpretation. Competences: professional competence, communicative/presentation competence
Contents	Basics in Sequence- and Seismic Stratigraphy, Facies Analysis of carbonate rocks, Methods in Hydrocarbon exploration. Within the Modul different depositional systems, and their characteristic features in Earth´s History will be presented with respect to their potential as source- and host rock potential.
Examination	Oral exam
Literature	Flügel 2004: Microfacies Analyses of Limestones Bally 1996: Atlas of Seismic Stratigraphy Vol 1-3 Mial: 2001 Basin Analysis
Further details	n.a.

DS 2 CAU: Elective courses

Module title	Petrology/Geochemistry
Module number	MNF-mgeo-MP5
Semester / duration	1 / 2 semesters
Coordinator	Prof. Dr. K. Hoernle
Courses	Isotope Geochemistry and Geochronology (L) Prof. Dr. Kaj Hoernle Prof. Dr. Volker Schenk Dr. Paul van den Bogaard Isotope Geochemistry and Geochronology (P) Prof. Dr. Kaj Hoernle Prof. Dr. Volker Schenk Dr. Paul van den Bogaard Magmatic Processes and Plate Tectonics (L) Prof. Dr. Kaj Hoernle Petrology-Geochemistry Seminar (S) Prof. Dr. Kaj Hoernle
Workload	150 h
Credits	5
Requirements	BSc Geosciences
Learning outcomes	Understanding and well-grounded background knowledge of isotope geochemistry and geochronology applied to magmatic and metamorphic rocks and their geological genesis; understanding of the influence of plate tectonics to melting processes. Lectures and practical exercise: professional competence 100%; seminar: professional competence 90%, communicative/presentation competence 10%
Contents	Basic knowledge of Sr-Nd-Pb-Hf-He isotope geochemistry and isotope geochronology (Rb-Sr, Sm-Nd, U-Th-Pb and Ar/Ar systematics) and of melting processes in relation to plate tectonics.
Examination	Oral exams, presentations
Literature	G. Faure: Principes of Isotope Geology K.G. Cox, J.D. Bell, R.J. Pankhurst: The Interpretation of Igneous Rocks
Further details	n.a.

Module title	MSc Coastal Geology I
Module number	MNF-mgeo-MP2
Semester / duration	1 / 2 semesters
Coordinator	Prof. Dr. Karl Stattegger
Courses	Coastal processes (L) Dr. Klaus Schwarzer Coastal Related Depositional Systems (L) Prof. Dr. Karl Stattegger Field work in Coastal Geology (E) Prof. Dr. Karl Stattegger Dr. Klaus Schwarzer
Workload	150 h
Credits	5
Requirements	BSc Geosciences BSc Physical Earth Sciences
Learning outcomes	Analysis of sedimentary structures, process-oriented classification of depositional environments in their temporal-spatial evolution, description and reconstruction of sediment-dynamic processes applied to the coastal zone of Schleswig-Holstein
Contents	Depositional environments and sedimentary processes in the coastal zone, case studies with examples from the coast of Schleswig-Holstein.
Examination	Written exam covering the lectures
Literature	Carter, R.W.G. (1988): Coastal Environments: 617 p.; London, San Diego, New York, Berkeley, Boston (Academic Press). Galloway, W.E., Hobday, D.K. (1996): Terrigenous Clastic Depositional Systems. 489 pp., Springer. Reineck, H.E., Singh, I.B. (1980): Depositional Sedimentary Environments, 2nd edition: 549 p.; Springer. Schäfer, A., 2005, Klastische Sedimente. 414 S., Elsevier. Woodroffe, C.D., 2002, Coasts. 623 S., Cambridge Univ. Press.
Further details	n.a.

Module title	Work Project Marine Geosciences
Module number	MNF-mgeo-WP
Semester / duration	3 / 1 semesters
Coordinator	Prof. Dr. Ralph R. Schneider
Courses	Work Project Marine Geosciences (P) Prof. Dr. Jan Behrmann Prof. Dr. Colin Devey Prof. Dr. Wolf-Christian Dullo Prof. Dr. Anton Eisenhauer Prof. Dr. Martin Frank Prof. Dr. Wolfgang Kuhnt Prof. Dr. Ralph R. Schneider Prof. Dr. Karl Stattegger Prof. Dr. Ing. Klaus Wallmann PD Dr. Dirk Nürnberg Research Seminar Marine Geosciences (S) Prof. Dr. Colin Devey Prof. Dr. Anton Eisenhauer Prof. Dr. Ralph R. Schneider Prof. Dr. Karl Stattegger Prof. Dr. Ing. Klaus Wallmann
Workload	300 h
Credits	10
Requirements	BSc Geosciences
Learning outcomes	Capability for independent analytical data acquisition and validation. Competence in scientific writing, presentation competence.
Contents	Application of marine geoscientific working methods, report writing and presentation of own project data.
Examination	Project report and presentation
Literature	Actual research articles will be provided in the seminar. Laboratory protocols and manuals are made accessible for project work.
Further details	n.a.

DS 3 CAU: Additionals in Marine Geosciences

Module title	Biogeochemistry
Module number	MNF-mgeo-MP4
Semester / duration	1 / 1 semesters
Coordinator	Prof. Dr. Ing. Klaus Wallmann
Courses	Marine Biogeochemistry (L) Prof. Dr. Ing. Klaus Wallmann Modelling in Marine Biogeochemistry (P) Prof. Dr. Ing. Klaus Wallmann
Workload	150 h
Credits	5
Requirements	BSc Geosciences
Learning outcomes	Understanding of complex biogeochemical fluxes in the ocean. Basic knowledge in biogeochemical modelling in the deep ocean. Professional competence
Contents	Comprehensive introduction to the complex biogeochemical Fluxes and exchange processes in the ocean and at the sediment-water-interface; modelling of eraly diagenesis; biogeochemical fluxes associated with fluidand gas venting.
Examination	Written exam
Literature	Broecker & Peng: Tracers in the Sea
Further details	n.a.

Module title	Chemical Paleoceanography
Module number	MNF-mgeo-CP
Semester / duration	1 / 2 semesters
Coordinator	Prof. Dr. Martin Frank
Courses	Organic compounds and Trace Metals in Sea Water (S) Prof. Dr. Anton Eisenhauer Prof. Dr. Martin Frank Chemical Paleoceanography (L) Prof. Dr. Martin Frank
Workload	120 h
Credits	4
Requirements	BSc Geosciences
Learning outcomes	Basic understanding of processes and interaction of controlling factors of marine environmental change in Earth´s History. Knowledge of state of the art chemical laboratory techniques applied to marine sediments.
Contents	Distribution and Depositional Environment of chemical sediments through Earth´s History. Analytical approaches to environmental information stored in marine sediments in the chemistry lab
Examination	Written exam and presentation
Literature	will be announced during lectures: G. Faure, Principles of Isotope Geology A.P. Dickin, Radiogenic Isotope Geology
Further details	n.a.

Module title	Evolution of Biosphere and Climate
Module number	MNF-mgeo-MP1
Semester / duration	1 / 1 semester
Coordinator	Prof. Dr. Priska Schäfer
Courses	Climate Reconstruction through Earth´s History (L) Prof. Dr. Ralph R. Schneider Basic Concepts in Paleontology (L) Prof. Dr. Wolfgang Kuhnt Prof. Dr. Priska Schäfer
Workload	120 h
Credits	4
Requirements	BSc Geosciences
Learning outcomes	Critical examination with innovative topics of paleontological research; Acquirement of methodology competence in paleontological and paleoclimatology. Acquisition of presentation skills by self-dependent work on special topics in paleontology and paleoclimatology.
Contents	Overview on innovative topics in Paleontology and their relation to Geosciences; Evolution of Climate during Earth´s History and their Impact and Feedback wioth the Biosphere.
Examination	Written exam covering the lectures
Literature	Stanley: Earth System History Ruddiman: Earth´s Climate Past and Future
Further details	n.a.

University of Potsdam

Extract from the module handbook of the M.Sc. Geosciences / Geology

DS 1 UP: Specialization

Module title	MGEW15 Permafrost Landscapes
Responsible party	Prof. Dr. H.-W. Hubberten
Additional teaching staff	Dr. B. Heim, Dr. H. Meyer, Dr. P. Overduin, Dr. L. Schirrmeister, Dr. G. Schwamborn, Dr. S. Wetterich
Semester	1
Language	German and/or English
Exam/Grading	Written exam, oral execise
Credit points	6
Number of participants	No limit
Recommended Background	no
Course Type	Lecture on the formation and degradation of Permafrost Landscapes. Exercises (seminar-type) partly conducted by students on special topics and lead by lecturers. Exercises (practice-type) on remote sensing methods.
Educational goals	To understand the principles of formation and the characteristics of permafrost as well as the formation and degradation of periglacial landscapes.
Module contents	This module gives an overview and insights of the formation and degradation of permafrost during the last glacial and interglacial cycle. The basic features of freezing and thawing processes of frozen ground and the related energy, water and element fluxes are explained. The complex relationship between these fluxes and the emission of greenhouse gases is covered, with a special focus on processes related to climate change. Typical permafrost landscapes and their degradation along with Arctic warming are studied using remote sensing methods. The consequences of warming permafrost landscapes on the environment and on infrastructure will be shown. Specific topics will be prepared and presented by the students in oral exercises.
Workload	180 h Total charge (30 h x 6 LP = 180 h) 45 h Lecture and exercise 135 h Homework and preparation of the exam
Teaching materials	Textbooks, articles, material provided in the internet, maps and air photographs, satellite data,
Literature	French, H.M., 2007, The Periglacial Environment. 3rd edition. Longman, Harlow, 341 pages

Module title	**MGEW13 Paleoclimate Dynamics**
Responsible party	PD Dr. Berhard Diekmann, apl. Prof. Dr. M. Trauth
Additional teaching staff	apl Prof. Dr. A. Brauer, Prof. Dr. U. Herzschuh
Semester	Optional
Language	German/ English (by arrangement)
Exam/Grading	Homework essay, talk, tests
Credit points	6
Number of participants	Unlimited
Recommended Background	Bachelor Course on Palaeoclimate
Course Type	Lectures and Exercises
Educational goals	Understanding of environmental processes and driving forces of the climate system through earth history.
Module contents	Modern atmospheric and oceanic circulation, dating problems, ice ages and greenhouse stages, global carbon cycle, palaeoclimate of low-latitude land areas, Quaternary geology of Europe, palaeoclimate of polar/subpolar regions.
Workload	180 h in total (30 h x 6 LP = 180 h) 30 h lectures 15 h exercises 15 h homework (essay) 120 h check of lectures
Teaching materials	Online handouts and online information on literature, text books, student contributions
Literature	Bradley, R.S., 1999, Paleoclimatology: Reconstructing Climates of the Quaternary, Academic Press, San Diego. Cronin, T.R., 2009. Paleoclimates - Understanding Climate Change Past and Present. Columbia University Press, New York, 448 pp.

DS 2 UP: Elective courses

Module title	**MGEP05 Sedimentäre Becken Sedimentary Basins**
Responsible party	Prof. Dr. Maria Mutti
Additional teaching staff	Department teaching staff
Semester	1
Language	Deutsch/Englisch,
Exam/Grading	Written or oral exam, Essay
Credit points	6
Number of participants	Not limited
Recommended Background	Fundamental concepts regading depositional processes and stratigraphy
Course Type	Lecture, practicals
Educational goals	Advanced knowledge of depositional processes and basin-fill stratigraphy
Module contents	Students will acquire in-depth knowledge of the methods of basin analysis, with a particular focus on carbonate systems. The role of subsidence, sea-level fluctuations and climate changes in affecting basin-fill stratigraphy will be discussed. During practicals, students will acquire knowledge of the pronciples of basin-fill and the processes controlling different environments of depositttion and their spatial distribution.
Workload	180 h total workload (30 h x 6 LP = 180 h) 45 h Lectures and practicals 135 h Own reading, exercises and preparation fort he exam
Teaching materials	Books and reading matertials of the internet pages of the department
Literature	Allen, P.A., Allen, J. R. , 2005, Basin analysis: principles and applications , Blackwell. Tucker, M., 1991, Carbonate Sedimentology, Blackwell. Angaben auf der Internetseite des Instituts

Module title	MGEW03 Petroleum Geology
Responsible party	Dr. G. Frijia, Dr. Michael Szurlies
Additional teaching staff	Department teaching staff
Semester	2
Language	English/German
Exam/Grading	Oral or written exam
Credit points	6
Number of participants	-
Recommended Background	-
Course Type	Lecture, Excercies, Field Practical
Educational goals	Introduction to Petroleum Geology and regional knowledge of petroleum systems
Module contents	This course will provide an overview over the geological conditions that lead to the developmement of petroleum reservoirs. Students will become familiar with the basic definitions used in Exploration Geology as well as with commonly used exploration methods. Furthermore, important reservoir systems in the world will be discussed.
Workload	180 h total workload (30 h x 6 LP = 180 h) 45 h lectures and exercises 135 h own pre- and post-reading, exercises, and exam preparation
Teaching materials	Books and reading materials of the internet pages of the department
Literature	Richard C. Selley, 1998, Elements of Petroleum Geology, Academic Press

Module title	**MGEW04 Events in Earth History**
Responsible party	Dr. M.Szurlies, Prof. Dr. M. Mutti, Dr. S. Tomas, Dr. G. Frijia,
Additional teaching staff	Department teaching staff
Semester	1, every two years
Language	German/English (by arrangement)
Exam/Grading	Seminar talk and written/oral exam
Credit points	6
Number of participants	Unlimited
Recommended Background	Fundamental concepts of stratigraphy and sedimentology
Course Type	Lectures, exercises, student oral presentations
Educational goals	Advanced knowledge in stratigraphy, Earth History and sedimentology. Skills in oral presentation and scientific discussion
Module contents	Students will acquire knowledge in events in Earth´s history and their impact on the geo- and biosphere (e.g. climate change, mass extinctions); students will give oral presentations, which will be discussed.
Workload	180 h total workload (30 h x 6 LP = 180 h) 45 h lectures and exercises 135 h own pre- and post-reading, exercises, and exam preparation
Teaching materials	Reading materials on the internet pages of the institute.
Literature	Kiessling, W., Flügel, E., Golonka, J., 2002, Phanerozoic Reef Patterns, SEPM Spec. Publ., Courtillot, V.E., Renne, P.R., 2003, On the ages of flood basalt events, C.R. Geosciences.

DS 3 UP: Additionals

Module title	**MScP01 Project Practical**
Responsible party	Prof. Dr. J. Tronicke, apl. Prof. Dr. M. Trauth, PD Dr. U. Altenberger
Additional teaching staff	Department teaching staff
Semester	3
Language	German/ English (by arrangement)
Exam/Grading	Written report (not graded)
Credit points	12
Number of participants	Unlimited
Recommended Background	None
Course Type	Practical training
Educational goals	In-depth practical knowledge in selected areas of geosciences. Studying and practicing presentation techniques
Module contents	Supervised field-, industrial, laboratory or computer-internship in a chosen field of geosciences. Preparation and presentation of the achieved results
Workload	360 h total workload (30 h = 360 x 12 credit hours) 280 h (35 days) Supervised internship 24 h internship search and application 40 h preparation of internship report 14 h preparing presentations 2 h seminar presentation
Teaching materials (or teaching tools)	Special materials on the website of the course
Literature	-