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future ocean
KIEL MARINE SCIENCES

2nd Young Scientist

EXCELLENCE CLUSTER CONFERENCE

on Marine and Climate Research: Perspectives from Natural and Social Sciences

4-5 October 2011

Bremen, Germany

BOOK OF ABSTRACTS

CONTENTS

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PREFACE

Welcome to the 2nd Annual "Young Scientist Excellence Cluster Conference on Marine and Climate Research: Perspectives from Natural and Social Sciences" (ECC) in Bremen. This conference is organized by and for PhD students and postdoctoral scientists from the three Excellence Clusters of Bremen (MARUM), Kiel (Future Ocean), and Hamburg (CliSAP), as well as associated institutes, and builds on the success of last year's PhD Student Conference "Integrated climate and earth system sciences in Northern Germany" in Hamburg.

The aim of this conference is to bring together early career scientists to present and discuss their research in an engaged, multidisciplinary environment and offer opportunities to discover potential synergies between wide-ranging topics, thereby fostering interdisciplinary research. Sessions are thus directed at highlighting specific issues approachable through different disciplines, such as biology, geology, chemistry, physics, economics, medicine, journalism, law, and politics. This is crucial for a holistic understanding of the integrated nature of the ocean - climate - society system.

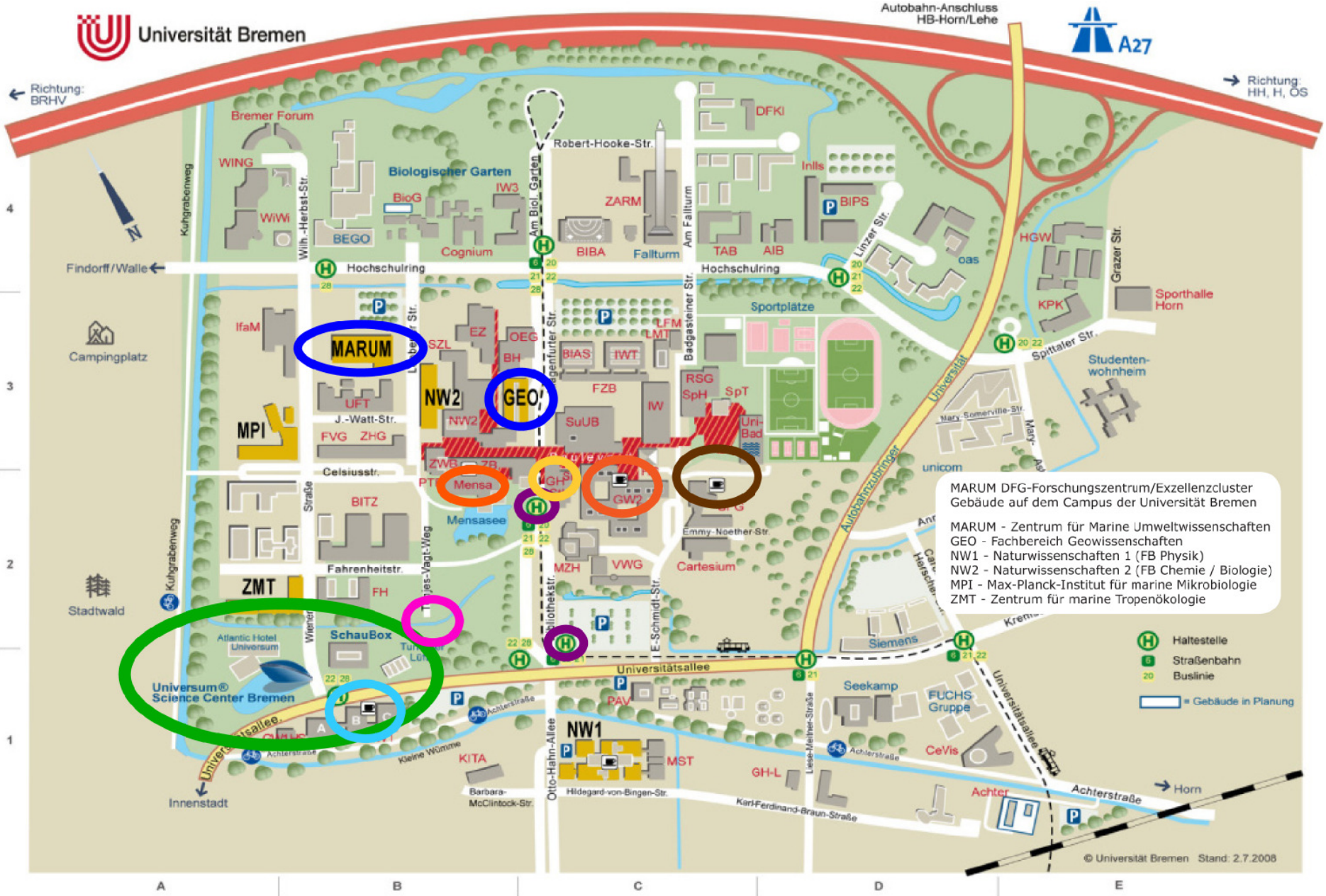
About 130 participants have registered and we received more than 90 excellent abstracts which are compiled alphabetically in this book.

We look forward to an exciting, fruitful and fun meeting.

Bremen, October 2011

The ECC organizing committee

LOCATION MAP AND ADDRESS


Universität Bremen
Autobahn-Anschluss HB-Horn/Lehe
A27
Richtung: BRHV
Richtung: HH, H, OS
Bremer Forum
WING
WiWi
BEGO
Biologischer Garten
BioG
IW3
Cognium
Robert-Hooke-Str.
Am Biol. Garten
ZARM
BIBA
Fallturm
Am Fallturm
DFKI
InIIs
BIPS
TAB
AIB
Linzer Str.
oas
HGW
Grazer Str.
Sporthalle Horn
KPK
Spittaler Str.
Studenten-wohnheim
Findorff/Walle
Hochschulring
Sportplätze
LFM
LMT
BIAS
IWT
FZB
RSG
SpH
SpT
Uni-Bad
IfaM
MARUM
SZL
EZ
OEG
BH
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GEO
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Atlantic Hotel Universum
SchauBox
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KITA
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Liese-Meitner-Straße
Barbara-McClintock-Str.
Hildegard-von-Bingen-Str.
Karl-Ferdinand-Braun-Straße
Achter
Horn
Innenstadt
MARUM DFG-Forschungszentrum/Exzellenzcluster
Gebäude auf dem Campus der Universität Bremen
MARUM - Zentrum für Marine Umweltwissenschaften
GEO - Fachbereich Geowissenschaften
NW1 - Naturwissenschaften 1 (FB Physik)
NW2 - Naturwissenschaften 2 (FB Chemie / Biologie)
MPI - Max-Planck-Institut für marine Mikrobiologie
ZMT - Zentrum für marine Tropenökologie
Haltestelle
Straßenbahn
Buslinie
= Gebäude in Planung
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A
B
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E
1
2
3
4

MARUM BUILDING

Leobener Strasse

D-28359 Bremen

GEO BUILDING

Klagenfurter Strasse

D-28359 Bremen

UNIVERSITY MENSA , CAFÉ CENTRAL & CAFETERIA IN GW2 BUILDING

University Boulevard

CAFÉ UNIQUE

Enrique-Schmidt-Straße 7

O'FLYNNS

Fahrenheitstraße 19-25 – Galileo Residenz

UNIKUM

Glass House – Universität Zentral Bereich

BIOBISS

University GW1 Building – Ground floor

UNIVERSUM BREMEN

Wiener Str. 1a

28359 Bremen

TRAM 6 STOPS

NW1 / Universum Science Centre (to Universum)

Universität Zentral Bereich (to MARUM and GEO buildings, Mensa)

CONFERENCE PROGRAMME

DAY 1 – 04 OCTOBER 2011

09:00-10:00 **Registration, poster hang-up & ice-breakerfast (MARUM Hall)**

10:00-10:30	**Welcome & Overview on the three Clusters of Excellence** **By Armine Avagyan (Hamburg), Ulrike Holzwarth (Bremen), and Jörn Schmidt (Kiel)**	**Geo-Building** **Hörsaal**

10:30-10:40 *Go to a room!*

10:40-12:00	**Global and regional biogeochemical cycles** (Convener: Armine Avagyan)	**MARUM** **2070**
10:40-11:00	**Judith Hauck (Alfred Wegener Institute for Polar and Marine Research)** Carbonate sediments on Antarctic shelves and implications for a mechanism to buffer Ocean Acidification in the Southern Ocean	
11:00-11:20	**Benjamin Runkle (Institute of Soil Science, KlimaCampus, University of Hamburg)** Clues to scaling from a field site to a region: lessons from a peatland-forest mire in northeast Russia	
11:20-11:40	~~**Regine Moll (Leibniz Center for Tropical Marine Ecology)**~~ *Canceled talk. The time of the presentations of the session will be adjusted.*	
11:40-12:00	**Maija I. Heller (IFM-GEOMAR)** Uncovering the key processes involved in manganese biogeochemical cycling in the Ocean.	

10:40-12:00	**Plankton dynamics: influencing factors and resulting impacts** (Convener: Martina Löbl)	**Geo-Building** **Hörsaal**
10:40-11:00	**Isabelle Schulz (Alfred Wegener Institute for Polar and Marine Research)** Response of a flagellate dominated plankton community to artificial iron enrichment in the Southern Ocean	
11:00-11:20	**Stefan Thiele (MPI for Marine Microbiology)** How does iron fertilization influence the bacterioplankton community? – A LOHAFEX report	
11:20-11:40	**Alexandra Kroll (IHF, KlimaCampus, University of Hamburg)** Modelling the interannual variability of two key phytoplankton groups	
11:40-12:00	**Sebastian Sonntag (IHF, KlimaCampus, University of Hamburg)** Phytoplankton species shifts affect upper ocean dynamics through biological-physical feedback mechanisms	

12:00-13:30 **Lunch (Mensa)**

13:30-15:00	**Past, present and future impacts of climate on society** (Convener: Andreas Schmidt)	**MARUM** **2070**
13:30-13:50	~~**Carsten Lemmen (Institute of Coastal Research, Helmholtz-Zentrum Geesthacht)**~~ *Canceled talk. The time of the presentations of the session will be adjusted.*	
13:50-14:10	**Henry Wu (MARUM)** Sub-seasonal climate reconstruction from southern Caribbean corals during the Classic Maya collapse	
14:10-14:30	**Liang Yang (CLISEC, KlimaCampus, University of Hamburg)** Trouble in mega-cities under a changing climate: Water scarcity and flood in Pearl River Delta, China	
14:30-14:50	**Michael Link & Jasmin Kominek (CLISEC, KlimaCampus, University of Hamburg)** The impacts of climate change on societal stability: modelling of complex systems	

13:30-15:00	**Marine ecology in a changing climate** (Convener: Rainer Kiko)	**Geo-Building** **Hörsaal**
13:30-13:50	**Jorge Rafael Bermúdez (IFM-GEOMAR)** Carbon dioxide affects copepod production by reducing nutritional quality of their algal diet	
13:50-14:10	**Chuanxi Xing (IHF, KlimaCampus, University of Hamburg)** Modeling the life cycle of a dormant species in the North Sea	
14:10-14:30	**Matthias Paulsen (Institute for Baltic Sea Fisheries)** Docasahexaeonic acid (DHA) affects nutrional condition of larval herring in the field	
14:30-14:50	**Ruiju Tong (Jacobs University)** Modelling the potential distribution of cold-water corals based on terrain parameters	

15:00-15:30 **Coffee break (MARUM)**

15:30-17:30	**Poster Session**	**MARUM** **Hall**

17:30-18:30	**Keynote lecture by Prof. Dr. Jürgen Scheffran (CLISEC, KlimaCampus, University of Hamburg)** Climate change and security: conflict or cooperation? (Convener: Bevis Fedder)	**Geo-Building** **Hörsaal**

18:30-19:00	**Information on early-career scientist organisation and meetings** (Convener: Ulrike Holzwarth)	**Geo-Building** **Hörsaal**
18:30-18:45	**YOUMARES 2.0 - 2nd Young Marine Research network meeting and conference 2011: Oceans amidst science, innovation and society** Stefan Meyer, Association for Marine Aquaculture, Büsum	
18:45-19:00	**Young Earth System Scientists** Florian Rauser, Max Planck Institute for Meteorology, Hamburg	

19:00 **Conference Dinner (MARUM hall)**

DAY 2 – 05 OCTOBER 2011

09:00-10:00	**Changing atmospheric dynamics? Insights from models and observations** (Convener: Sebastian Sonntag)	**MARUM** **2070**
09:00-09:20	**Felix Bunzel (Max Planck Institute for Meteorology)** Stratosphere dynamics in a changing climate - sensitivity simulations with ECHAM6	
09:20-09:40	**Katrin Lonitz (Max Planck Institute for Meteorology)** Trade-cumuli statistics compiled from cloud radar measurements on Barbados	
09:40-10:00	**Vera Schemann (Max Planck Institute for Meteorology)** Scale (in)dependency of statistical cloud cover parametrizations	

09:00-10:00	**Interactions on the seafloor: sediment dynamics and gas emissions** (Convener: Lucia Korff)	**Geo-Building** **Hörsaal**
09:00-09:20	**Eva Kwoll (MARUM, University of Bremen)** Transport of suspended matter in the form of turbidity clouds in the Elbe Estuary	
09:20-09:40	**Stefan Wenau (MARUM, University of Bremen)** Structure of fluid seepage sites and associated BSR distribution on the salt-controlled Angola continental margin	
09:40-10:00	**Jan-Hendrik Körber (MARUM, University of Bremen)** Investigating oil and gas seepage in the Eastern Black Sea by remote sensing	

10:00-11:00 **Coffee break + revisiting posters (MARUM)**

11:00-12:00	**Key note lecture by Prof. Dr. Mojib Latif (IFM-GEOMAR)** Climate change - fact or fiction? (Convener: Leticia Cotrim da Cunha)	**Geo-Building** **Hörsaal**

12:00-13:30 **Lunch (Mensa)**

13:30-15:15	**Societal responses to climate and marine issues - assessing approaches and challenges** (Convener: Ewelina Riekens)	**MARUM** **2070**
13:30-13:50	**Korbinian Freier (International Max Planck Research School on Earth System Modelling)** Traditional Management and Solar Energy - Options for Adapting Pastoralism in Semi-Arid Areas to Climate Change	
13:50-14:10	**James Hollway (Bremen International Graduate School of Social Sciences)** Taking Stock of Global Fisheries Governance, 1950-2010	
14:10-14:30	**Ute Kapaun (Department of Economics, University of Kiel)** The EU multiannual plan for the Baltic cod stock - A reasonable fishery management option?	
14:30-14:50	**Bevis Fedder (Research Center for European International Law/GLOMAR, Bremen)** Access and Benefit Sharing in the Marine Realm - Challenges to Justice, Effectiveness, and Research and Development	
14:50-15:10	**Ana Ivanova & Andreas Schmidt (CliSAP, Research Group Media Constructions of Climate Change)** Public Legitimization of Global Climate Politics? A Comparative Study of Media Coverage in 18 Countries	

13:30-15:15	**Understanding ocean & climate dynamics** (Convener: Cyril Giry)	**Geo-Building** **Hörsaal**
13:30-13:50	**Lucia Korff (University of Bremen)** Evidence for climate-driven cyclic changes in bottom water ventilation from paleomagnetic, rockmagnetic and geochemical records of Late Pleistocene sediments from the North Pacific	
13:50-14:10	**Vera Barbara Bender (MARUM, University of Bremen)** Holocene shelf-slope sediment dynamics off Uruguay (36°S) under the light of shifting paleoceanographic fronts	
14:10-14:30	**Bente Tiedje (Institute of Oceanography, KlimaCampus, University of Hamburg)** Potential predictability of North Atlantic heat transport based on an oceanic state estimate	
14:30-14:50	**Laura Niederdrenk (Max Planck Institute for Meteorology)** Modelling the Arctic hydrologic cycle	
14:50-15:10	**Anja Rösel (Center for Marine and Atmospheric Research Institute of Oceanography, University of Hamburg)** Melt ponds on Arctic sea ice determined from MODIS satellite data	

15:15-15:45 **Coffee break (Geo-Building)**

15:45-16:15	**Awarding ceremony and closing**	**Geo-Building** **Hörsaal**

LIST OF POSTERS

Family name	First name	Affiliation	Title	Subject	Poster label
Wilkens	Nina	Institute of Geophysics, University of Hamburg	A 3D full-Stokes finite-element model for Pine Island Glacier	Polar climate	AC2
Hand	Ralf	IFM-GEOMAR	Modelled Atmospheric Response to SST Variability in the Gulf Stream Region	Atmospheric dynamics	AD1
Zhuang	Guangchao	Organic Geochemistry Group,MARUM, University of Bremen	Trace Analysis of Methylated Substrates in Marine Sediment	Biogeochemistry	BG1
Winterfeld	Maria	Alfred Wegener Institute for Polar and Marine Research & University of Bremen, Dept. of Geosciences	Molecular characterization of terrestrial, permafrost-derived organic matter along a soil-river-ocean transect (Lena Delta, NE Siberia)	Biogeochemistry	BG2
Basse	Andreas	MARUM/AWI	Can laterally advected intermediate nepheloid layers affect the efficiency of the biological pump? – a biomarker study of sub-surface alterations of marine snow aggregates off Cape Blanc, NW Africa	Biogeochemistry	BG3
Schwichtenberg	Fabian	CliSAP	Impact of alkalinity fluxes on the carbon cycle in the southern North Sea	Biogeochemistry	BG4
Grombik-Suwała	Iwona	IFM-GEOMAR, Marine Biogeochemie	Collected data? Did you QC the data and submit to data-center?	Database/chemistry	BG5
Kleber	Joscha	Institute of Physical Chemistry, Christian-Albrechts-University Kiel, Future Ocean	Studying heterogeneous monolayer kinetics by quantitative VSFG spectroscopy: The oleic acid - ozone reaction system	Chemistry	C1
Mewes	Konstantin	Alfred-Wegener-Institut für Polar- und Meeresforschung	Geochemical processes in sediments of the German license area for polymetallic nodule exploration in the NE Pacific Ocean	Geochemistry	C2
Hoshyaripour	Gholamali	Institute of Geophysics, KlimaCampus, University of Hamburg	How do volcanoes produce bio-availabe iron: New insights from modeling gas/aerosol-ash interaction inside the hot core of volcanic plumes	Geophysics	GP1
Metzner	Doreen	IFM-GEOMAR	Southern Hemisphere climate response to an extremely large volcanic eruption	Geophysics	GP2
Xing	Junhui	Marine Technology – Environmental Research Group, University of Bremen	Shallow gas transport and reservoirs in the vicinity of deeply rooted mud volcanoes in the central Black Sea	Geophysics	GP3
Toth	Zsuzsanna	Uniersity of Bremen	Geoacoustic properties of shallow gas accumulations in Baltic Sea sediments – which can be used for quantification?	Geophysics	GP4
Havemeyer	Sandra	MARUM, University of Bremen	Polyphosphate storage in Beggiatoa alba	Microbiology	MB1
Kraft	Beate	Microbial fitness group, Max-Planck-Institute for Marine Microbiology	Competition between microbial nitrate reduction processes	Microbiology	MB2
Zhu	Rong	MARUM, University of Bremen	Detection of Microbial Biomass in Subseafloor Sediments by Pyrolysis-GC/MS	Microbiology	MB3
Wolff	Katrin	Alfred Wegener Institute for Polar and Marine Research & MARUM / University of Bremen	Seasonality of dust found in the Holocene and glacial period of the NGRIP ice core.	Paleoclimate	PC1
Mildner	Tanja	Institute of Oceanography, University of Hamburg	Loop Current variability due to wind stress and reduced sea level during the Last Glacial Maximum (LGM)	Paleoclimate	PC3
Giry	Cyril	MARUM - University of Bremen	Changes in tropical Atlantic temperature seasonality over the last 6200 years as documented in coral Sr/Ca records	Paleoclimate	PC4
Zhang	Dan	Max Planck Institute for Meteorology; KlimaCampus, University of Hamburg	Climate variability in China in the last 1200 years in simulations and reconstructions	Paleoclimate	PC5
Holzwarth	Ulrike	MARUM , University of Bremen	Separating natural variability from anthropogenic induced changes: an example from Western Sahel	Paleoclimate	PC6
Kuechler	Rony	MARUM – University of Bremen	Rainfall variability over NW Africa during the last glacial-interglacial cycle: a δD record of the last 120 ka	Paleoclimate	PC7
Vallé	Francesca	MARUM, University of Bremen	A palynological study to assess the influence of the Atlantic overturning circulation on West African vegetation and climate during the Pliocene	Paleoclimate	PC9
Heinze	Mathias	Max Planck Institut für Meteorologie	Modeling the full carbon cycle during the PETM	Paleoclimate	PC10
Hoetzel	Sebastian	MARUM, University of Bremen	Impact of Benguela Upwelling (Namibia) - Intensities of the last 10 Ma and Effects on Continental Vegetation	Paleoclimate	PC11
Chen	Wenwen	University of Bremen, GLOMAR	Reconstruction of sea surface temperature in the eastern Indian Ocean during the last 22000 years	Paleoclimate	PC12
Uliana	Eleonora	MARUM, University of Bremen	Testing a new temperature proxy in an eastern boundary current system (SE Pacific off Chile)	Paleoclimate	PC13
Saavedra-Pellitero	Mariem	University of Bremen	Pacific sector of the Southern Ocean coccolithophores and their paleoceanographic significance	Paleoclimate	PC14
Preu	Benedict	MARUM – University of Bremen	Sedimentary pattern on the northern Argentine slope: the impact of North Atlantic Deep Water on southern hemisphere slope architecture	Paleoclimate	PC15
Nagai	Renata	Oceanographic Institute, São Paulo University, Brazil	Tracing the Holocene impact of the La Plata River over the S Brazilian shelf	Paleoclimate	PC16
Loebl	Martina	MARUM, GLOMAR	Success of the new phytoplankton species Mediopyxis in the North Sea	Plankton ecology	PE1
Fuchs	Nike	Alfred Wegener Institut Bremerhaven	Valve Size Frequency distribution of Fragilariopsis kerguelensis as a paleoproxy for Southern Ocean Productivity	Plankton ecology	PE2
Kiko	Rainer	IFM-GEOMAR, Future Ocean	Acclimation and adaptation to hypoxia resolved through transcriptional profiling of in situ fixed zooplankton	Plankton ecology	PE3

Family name	First name	Affiliation	Title	Subject	Poster label
Kunst	Oliver	KlimaCampus / Universität Hamburg	Reducing cache misses on tetrahedral meshes by intelligent element numbering	Physical oceanography	PO1
Kuhlmann	Julian	GFZ Potsdam	Improved Modelling of Sea-Level Patterns by Incorporating Self-Attraction and Loading	Physical oceanography	PO2
Brüggemann	Nils	Universität Hamburg	Upper-ocean small and meso-scale processes	Physical oceanography	PO3
Brüdgam	Michael	KlimaCampus/Clisap Hamburg	Towards the ability of the Adjoint technique to recover decadal variability in the North Atlantic	Physical oceanography	PO4
Roessler	Achim	Institute for Environmental Physics, Oceanography Division, University of Bremen	Sustained observations of the North Atlantic Current	Physical oceanography	PO5
Li	Mingming	Department of Oceanography, Institute of Environmental Physics, University of Bremen	A study of diapycnal mixing in the North Atlantic	Physical oceanography	PO6
Köhler	Janna	Institute of Environmental Physics, Department of Oceanography, University Bremen	Temporal variability of internal waves in the Deep Western Boundary Current at 16°N	Physical oceanography	PO8
Carson	Mark	Institute of Oceanography, KlimaCampus, Universität Hamburg	Low-frequency variability of regional sea level in millennium climate model simulations	Physical oceanography	PO9
Schleupner	Christine	Research Unit Sustainability and Global Change, KlimaCampus, Hamburg University and CEN	Modelling the Implications of Climate Change for European Freshwater Wetland Distributions	Societal-climate interactions	SC1
Riekens	Ewelina	GLOMAR/artec	The new "macro-regional cooperation approach" and the EU Strategy for the Baltic Sea Region.	Societal-climate interactions	SC2
Traini	Camille	Institut für Geowissenschaften Exzellenzcluster "Ozean der Zukunft", Meeresspiegelanstieg und Küstenerosion	Estuarine processes and grain size distribution of suspended particulate matter within the São-Francisco Delta, Brazil	Sediment dynamics	SD1
Held	Philipp	Institute of Geosciences at Kiel University	On the dynamics of Internal Waves in the Ems-Estuary	Sediment dynamics	SD2
Bartzke	Gerhard	MARUM, University of Bremen	On the stabilizing influence of Silt on Sand beds	Sediment dynamics	SD3

POSTERS OF THE EXCELLENCE CLUSTERS AND GRADUATE SCHOOLS					
MARUM	-	MARUM, Bremen	The Ocean in the Earth System	Excellence Cluster	MARUM
KlimaCampus	CliSAP	CliSAP/KlimaCampus, Hamburg	CliSAP/KlimaCampus: Excellent Climate Research in Hamburg	Excellence Cluster	CliSAP
Söding	Emanuel	The Future Ocean, Kiel	The Future Ocean – 2012 and beyond	Excellence Cluster	Future Ocean
Klose	Christina	GLOMAR, Bremen	The Bremen International Graduate School for Marine Sciences – GLOMAR	Graduate School	GLOMAR
Avagyan	Armine	SICSS, Hamburg	Interdisciplinary MSc and Doctoral Education in Climate System Science at the University of Hamburg	Graduate School	SICSS
Antia	Avan N.	ISOS, Kiel	Education for „The Future Ocean": Kiel Marine Sciences	Graduate School	ISOS

POSTERS WITHDRAWN					
Sasgen	Ingo	German Centre for Geosciences GFZ, Geodesy and Remote Sensing, Potsdam	Accumulation variability in West Antarctica related to ENSO from satellite gravimetry	Polar climate	AC1
Khélifi	Nabil	IFM–GEOMAR	Changes in North Atlantic deep water circulation, 3.3 – 3.0 Ma	Paleoclimate	PC8
Chacón-Barrantes	Silvia	CORELAB, University of Kiel	Numerical modelling of the morphological changes caused by tsunamis on Reef Islands.	Sediment dynamics	SD4
Karbe	Fritz Richard	Institute of Environmental Physics, University of Bremen	Deep Western Boundary Current observations off Flemish Cap during 2009 - 2011.	Physical oceanography	PO7
Liu	Huadong	Geosystem modeling, FB5, Universität Bremen	Hydroclimatologic variability in the Tropics during Termination 1 and the Holocene	Paleoclimate	PC2

LIST OF ABSTRACTS

ORAL PRESENTATION ABSTRACTS

POSTER PRESENTATION ABSTRACTS

ABSTRACTS

On the stabilizing influence of Silt on Sand beds

Gerhard Bartzke[1,2], Karin Bryan[2], Conrad Pilditch[3] and Katrin Huhn[1]

[1] MARUM – Center for Marine Environmental Sciences and Faculty of Geosciences, University of Bremen, Germany
[2] Department of Earth Sciences, University of Waikato, Hamilton, New Zealand
[3] Department of Biological Sciences, University of Waikato, Hamilton, New Zealand

During storm events sediments from different sources are stirred and dispersed generating beds that are composed of mixed- and layered sediments. Predicting the entrainment characteristics of these types of sediments is therefore a key challenge for coastal engineers. With the objective to investigate the controlling parameters stabilising a sediment bed, we tested deposited- and mixed sediment beds by using an analogue, laboratory based Annular Flume and a simplified treatment of two grain fractions with respect to silt and sand. In parallel, a high resolution 3D numerical model was developed using the Discrete Element (DEM) and Finite Difference (FDM) Method. The model resolves a small region of the flume tank and enables detailed study of the small-scale physical processes that account for the behaviour observed in the lab. Two suites of experiments were designed:
(1) "The Deposition Experiment": a sandy bed was covered by a thin layer of silt of varying thickness; (2) "The Mixing Experiment" the bed was composed of sand mixed with small amounts of silt.
All samples were tested for their stability effects using increasing flow speeds up to 30cm/s induced by a rotating lid. In both experimental series the sediment bed stabilised with increasing silt load. These observations could be interpreted by pore space plugging and changes in the surface roughness affecting an inflow reduction and hence an increased resistance to erosion. Numerical simulations confirm this interpretation.

Can laterally advected intermediate nepheloid layers affect the efficiency of the biological pump? – a biomarker study of sub-surface alterations of marine snow aggregates off Cape Blanc, NW Africa

Andreas Basse[1,2], Prof. Gesine Mollenhauer[1,2,3], Dr. Morten Iversen[3,1], Dr. Gerd Fischer[3,1],

[1] MARUM
[2] AWI
[3] Universtity of Bremen

We analyzed particulate organic matter samples (POM) collected with in-situ pumps, core top sediment samples, and surface water filtrations along an EW-transect off Cape Blank.
We found the lipid composition of the POM to change significantly with water depth. This suggests that degradation processes at all depths alter the POM as it sinks, and/or that the NLs contain distinct lipids which are scavenged by the POM aggregates during their vertical flux through the NLs.
We measured $U^{K'}_{37}$, TEX_{86}, fatty acids and diverse other lipids. The $U^{K'}_{37}$ showed no significant changes throughout the water column, indicating that the $U^{K'}_{37}$-Index is not affected by lateral transport and alteration. The TEX_{86}, fatty acid composition and other lipids however, showed significant variations often correlating with the nepheloid layers. This implies that the material in the NLs has either 1) a different source of POM compared to the water layers above and below the NLs, or 2) that the POM in the NLs undergoes different alteration processes than the rest of the POM in the water column.

References

Fischer, G., Karakas, G., Blaas, M. Ratmeyer, V., Nowald, N., Schlitzer, R., Helmke, P., Davenport, R., Donner, B., Neuer, S. and Wefer, G. (2007). doi 10.1007/s00531-007-0234-7.

Karakas, G., Nowald, N., Blaas, M., Marchesiello, M., Frickenhaus, S. and Schlitzer, R. (2006). doi:10.1029/2005JC003296, 2006.

Iversen, M. H., Nowald, N., Ploug, H., Jackson, G. A., and Fischer, G.: doi: 10.1016/j.dsr.2010.1003.1007, 2010.

Holocene shelf-slope sediment dynamics off Uruguay (36°S) under the light of shifting paleoceanographic fronts

Vera B. Bender[1,2,3], Till J. J. Hanebuth[3], Cristiano M. Chiessi[4,5], Tilo v. Dobeneck[1,2]

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Here we discuss data retrieved from an exceptional core location at the uppermost Uruguayan slope. A 20-km long terrace right underneath the shelf break (shelf break ca. 200 m water depth, terrace ca. 250 m water depth) gives the rare opportunity to directly record variations in shelf export through time and thus gain insights into the genetic evolution of the shelf system and the shelf–slope linking processes.
Furthermore this area is located within one of the most energetic regions of the world oceans arising from the confluence of two major western boundary currents, the northward-flowing cold and nutrient-rich Malvinas Current and the southward-flowing warm and nutrient-depleted Brazil Current. Within this conjunction, referred to as the Brazil-Malvinas Confluence, steep sea-surface temperature gradients of up to 1°C km^{-1} are found.
During the Holocene clastic sedimentation on the terrace was enormously high (up to 200 cm/ka) enabling exceptionally high temporal resolution studies. Grain size proxies and εNd data indicate a constant Argentine shelf source (south of the study area) for the terrigenous fraction. Contrastingly, *Cibicides mckannai* $\delta^{18}O$ and benthic foraminifera assemblages indicate a change from a strong fluvial and cold water dominated source during the early Holocene towards a less fluvially influenced and more temperate water source over the terrace during the late Holocene. It emerges that Holocene climatic variations may had an influence on the upper ocean frontal system but did not affected general terrigenous sediment supply to the terrace.

Carbon dioxide affects copepod production by reducing nutritional quality of their algal diet

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The reaction of carbon dioxide (CO_2) with water generates one proton (H^+) for each bicarbonate ion (HCO_3^-) and two protons for each carbonate ion (CO_3^{2-}) formed, decreasing the water pH. Is known that this reaction affects several primary producers such as coccolithophores, whereas diatoms show a change in their total lipid content when cultured under high-CO_2 conditions. Fatty acid (FA) composition is a critical factor that regulates energy transfer efficiency between primary producers and consumers since essential FAs cannot be synthesized *de novo* by heterotrophic organisms and have to be acquired through their diet. Polyunsaturated fatty acids in particular, play an important role in growth, development and reproduction processes of heterotrophs. A CO_2 related pH-decrease seems to be a significant factor causing shifts in the FA composition of several phytoplankton species, which may have important consequences for primary consumers and higher trophic levels. In a full factorial laboratory experiment, the copepod *Acartia tonsa* was grown at ambient (380 ppm) and increased (740 ppm) CO_2 and fed with *Thalassiosira pseudonana* cultured under the same conditions. Development, egg production rate and FA content per female were measured. The results show that these three parameters are all reduced when fed with *T. pseudonana* cultured at high CO_2 conditions. We therefore conclude that CO_2 concentration affects the fatty acid composition of *T. pseudonana* and that this alteration has a significant influence on the lifecycle of *A. tonsa*. Further research is required to determine if the observed effects also occur in the natural environment.

Towards the ability of the Adjoint technique to recover decadal variability in the North Atlantic

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The Atlantic Meridional Overturning Circulation (AMOC) has an important influence on the today's climate. However, continuous decadal-scale observations of the AMOC are not existing. Therefore, available ocean observations are assimilated into numerical ocean models to estimate the AMOC's mean state and its variability. Even the entire oceanic database is too sparse to appropriately constrain oceanic data assimilation.
Hence, different data assimilation products show rather different AMOC mean states and variability. To understand these differences, we consider a reversed data assimilation approach: Is a prescribed pertubation from a controlled setup with known synthetic measurements perfectly reproducible in space and time?
The gedanken experiment evaluates the principle ability of the adjoint technique to recover given variability in the AMOC. We investigate how far deviations between model and synthetic observations can be minimized in the presence of artificial observational uncertainties and non-linear effects, as e.g. convection. The results are used to assess error estimates of present assimilation products and AMOC hindcast simulations.

Upper-ocean small and meso-scale processes

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The surface layer of the ocean is very turbulent and small scale dynamics play an important role for some climate relevant issues like the air-sea gas exchange of greenhouse gases and surface heat fluxes. Unfortunately current global ocean models are still not able to resolve these small scales due to high computational coasts.
In this study we analyze the influence of these small scale processes on the air-sea gas exchange and test attempts for parameterizing these processes which allow to represent the most important effects within the mixed layer in coarser resolved ocean climate models.

Stratosphere dynamics in a changing climate – sensitivity simulations with ECHAM6

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When planetary waves originating from the troposphere propagate upward and dissipate in the stratosphere, they force a stratospheric meridional overturning circulation, the Brewer-Dobson Circulation (BDC). Air masses enter the stratosphere at the tropical tropopause via tropical upwelling, before they are being transported toward the poles, where air parcels on the upper branch of the circulation eventually sink back into the troposphere. A correlation between the strength of this transport circulation and the strength of the polar vortex in northern hemispheric winter was found to exist. The weaker the polar vortex is, the stronger is the BDC. A change in the strength of the polar vortex in turn is likely to change the frequency of strong and weak vortex events, such as sudden stratospheric warmings. During these events a signal in the northern annular mode index is propagating downward, which at the surface is correlated to the severity of winters in Europe and Eurasia.

The increase in tropical sea surface temperatures, as a consequence of a greenhouse gas (GHG) induced climate change, was found to modify both wave generation in the troposphere as well as wave propagation up into the stratosphere. Models predict that this leads to an increase in tropical upwelling and, thus, a strengthening of the BDC.

Sensitivity simulations for preindustrial, present-day and future climate conditions were performed with the state-of-the-art general circulation model ECHAM6. The results of these simulations with regard to the change in stratosphere dynamics and indications for the responsible mechanisms are being presented. Additionally, the impact of the model configuration will be discussed.

Low-frequency variability of regional sea level in millennium climate model simulations.

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Estimates of the low-frequency variability in model simulations of SSH are explored in terms of time scale and spatial pattern. The data come from the German Millennium project, based on the coupled ECHAM/MPI-OM model, in which the last 1000 years were simulated. From those runs over 3000 years of data are available in the control run, and over 1200 years of data in the forced ensemble runs. Maps of the spatial scale and time scales show significant variability on decadal to multi-centennial timescales, especially in the subpolar and polar regions. Interannual variability (periods shorter than 10 years), is nearly global in extent. Notable exceptions include some polar regions, and portions of the midlatitude North Pacific and North Atlantic Oceans. Exploration into underlying dynamics shows that advection may play a large part of the SSH variability, as thermosteric and halosteric changes are largely anti-correlated, suggesting advection plays a larger role than locally-forced changes. Selected regional changes are examined in further detail.

Numerical modelling of the morphological changes caused by tsunamis on Reef Islands.

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Coral reef islands are very vulnerable to sea level rise. Despite of the fact that the most common concern is global warming and storms, very little is known about the effect of tsunami waves on the morphodynamics. After the 2004 Sumatra tsunami, a comprehensive study of the tsunami consequences on several islands of one atoll in Maldives was done. On the basis of it a conceptual model of tsunami mechanism and consequences was proposed.
The objective of the current investigations is to reproduce and confirm the conceptual model with the help of a high resolution morphodynamic model.
In this study process based models for simulation of flow, sediment transport and morphodynamics covering the entire Indian Ocean have been developed. Preliminary results of the application of the model using a real sea level record for the simulation of the morphological changes in the vicinity of the atoll in Maldives are presented.

Reconstruction of sea surface temperature in the eastern Indian Ocean during the last 22000 years

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The climate system in the tropical eastern Indian Ocean off Java is characterized by the East Asian Monsoon with strong seasonality with regard to precipitation, sea surface temperatures (SSTs) and upwelling. This region has been inferred to have a larger impact on regional and global climate, however, the oceanic & atmospheric processes remain poorly understood.
In this study we reconstructed SST with two lipid-based biomarkers as proxies from a sediment core (GeoB10053-7) and a sediment trap (Jam2) from the Indonesian continental margin off Java.
Results from the sediment trap show that the alkenone flux rapidly increases during upwelling (SE monsoon), similar to the TOC content of the samples. Alkenone flux is also elevated at the end of the NW monsoon in February/March, during increased riverine nutrient discharges following the rainy season. The GDGTs flux shows a similar record but less pronounced seasonality. However, the $SST_{Uk'37}$ is warmer than TEX_{86} temperature during upwelling season.
The age model of core GeoB10053-7 for the last 22,000 years is based on AMS ^{14}C dates. TEX_{86} temperature increases from 22 kyr to present-day. $SST_{UK'37}$ decreases from 22kyr to 17kyr and increases since the last 16kyr until today. Both of them show a different pattern. Our results show that TEX_{86} temperature reflects the temperature of upwelling season and $SST_{Uk'37}$ does not reflect the temperature of upwelling season, even though the bulk of the flux occurs during the upwelling season.

Access and Benefit Sharing in the Marine Realm – Challenges to Justice, Effectiveness, and Research and Development

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Genetic resources are the raw material for research and development. Since many stakeholders with clashing interests are keen on getting their share of the benefits, legal regulation is imperative. The major international instrument regulating activities on genetic resources is the Access and Benefit Sharing Regime (ABS) under the Convention on Biological Diversity.
The common view on ABS entails bilateral exchange of genetic resources (provider side) in return for a share of the benefits (user side). This study contests this bilateral exchange as it renders the ABS system not only unjust and ineffective but also hampers research and development. Bilateral exchange is unjust because all other states where same genetic resource occurs leave empty-handed when it comes to benefit sharing. It is ineffective since the major burden of monitoring cannot be carried by the provider of genetic resources alone. And it hampers research and development, since providers adopt overly restrictive regulations to prevent illegitimate uses of genetic resources.
Biological databases provide a useful tool to ameliorate these deficiencies. They increase justice by identifying all other states where same genetic resource occurs. Thus, all beneficiaries can be identified. Biological databases improve effectiveness by providing instruments to monitor the use of genetic resources. These include references to relevant scientific publications, patents, trademarks, and companies. Finally, databases promote research and development, since providers do not rely on overly restrictive regulations to monitor uses and ensure legitimacy.
In conclusion, biological databases carry much potential to improve the ABS system.

Traditional Management and Solar Energy - Options for Adapting Pastoralism in Semi-Arid Areas to Climate Change

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A likely decrease in precipitation during the 21st century will threaten pastoralism as major income source in many subtropical semi-arid areas. In a case study in southern Morocco, we apply qualitative methods as well as a quantitative regional bio-economic model to assess possibilities of adapting pastoral land use to climate change.
Our qualitative analysis shows that the current trend of sedentarization of former mobile pastoralists is likely to be enforced if precipitation is reduced. However, predictability of the land users' reactions is limited. Using this result as input for a bio-economic model, it shows that increasing sedentarization proportional to estimated population growth will amplify impacts from reduced precipitation. While traditional mobile pastoralists are less affected and might be even able to compensate impacts, sedentary pastoralists are likely facing reductions of income from pastoralism by 23-37% for different drought scenarios. The current policy paradigm of many governments in semi-arid areas of settling former mobile pastoralists is therefore contra productive in order to adapt to climate change impacts. Additionally, our model shows an interesting potential of solar power generation in semi-arid areas: Rangeland condition in these areas is currently negatively affected by collection of firewood which is the dominant energy source of rural households. If this energy demand could be satisfied with solar electricity, our model shows that impacts from climate change on sedentary livestock husbandry can be compensated.

Valve Size Frequency distribution of Fragilariopsis kerguelensis as a paleoproxy for Southern Ocean Productivity

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Unraveling the role of the Southern Ocean's biological pump in regulating climate would be enhanced by the development of paleoceanographic proxies specific to carbon or silica cycling. Observations that the average size of valves of the diatom, *Fragilariopsis kerguelensis*, varies seasonally, with latitude, and over glacial-interglacial cycles in the Southern Ocean suggest that the valve size frequency distribution in sediments could be used to reconstruct aspects of paleoproductivity and silica cycling. We aim to develop this proxy by using culture, field and sediment samples to determine the exact controls on valve size frequency distributions, the most important of which is likely to be the frequency of auxospore formation within the population. The controls on auxospore formation are as yet unknown and both mating experiments in culture as well as in situ iron fertilization experiments are likely to unravel the mechanisms determining auxospore formation under both controlled and field conditions. The valve size frequency distribution can then be used to indicate the intensity of the environmental and/or biological conditions triggering auxospore formation.

Changes in tropical Atlantic temperature seasonality over the last 6200 years as documented in coral Sr/Ca records

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Observational studies indicate that the largest temporal variation of sea surface temperature (SST) in the Atlantic Ocean occurs at annual period. However, knowledge about the magnitude of SST variability on this time scale is limited to ~150 years of instrumental record. Here we assess the magnitude of the annual SST cycle for pre-industrial times by using monthly-resolved records of Sr/Ca (proxy of SST) from three modern and six well-dated (U-series) fossil annually-banded *Diploria strigosa* corals from Bonaire (southern Caribbean Sea). Each coral record reveals clear annual cycles and provides time-windows of up to 68 years length. The total number of 295 years of record allows for assessing the natural range of SST seasonality in the western tropical Atlantic. Monthly Sr/Ca-SST records from modern corals satisfactorily document modern SST seasonality at Bonaire (~2.9°C). Fossil corals which grew during pre-industrial times provide evidence for changes in the magnitude of annual SST variations over the last 6200 years. The coral records, combined with climate model simulations reveal that tropical Atlantic SST seasonality is influenced by insolation changes on orbital timescales. In addition, the coral record at 2.35 ka indicates significant increased SST seasonality (4.4°C) that is unprecedented over the instrumental data period. Spectral analyses of this coral record which grew during period of severe El Niño/Southern Oscillation (ENSO) activity indicate prominent interannual variability at typical ENSO periods. Therefore, coral records from Bonaire imply that ocean-atmosphere interactions were critical in controlling western tropical Atlantic SST seasonality during the Holocene.

Collected data? Did you QC the data and submit to data-center?

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Emission of anthropogenic CO_2 to the atmosphere changes the global heat balance and the ocean CO_2 content. Other changes to the ocean, possibly climate related, include changes in oxygen and nutrient content due to changes in ventilation and/or biology. Detection of these changes requires consistent and accurate interior carbon chemical data. However, only the small percentage of the ocean has been tracked by research cruises that collect high quality chemistry data, it is not well understood how the oceans are changing with time. Collection of interior ocean carbon data as a part of projects such as CARINA, PACIFICA and GLODAP provides consistent data sets for all major ocean basins.
A data portal created at the IFM-GEOMAR provides a local repository of data accessible to scientists tied to particular projects. Initially, all data from different groups is uploaded and subsequently merged into standard format data files. In a second phase, hydrochemistry data is being fed into a relational data base.
Original data from available cruises are collected to create merged consistent data products. One of the most important steps to obtain consistency of the data is comparison of various chemistry parameters from different cruises and removing the systematic biases of the data by a process known as secondary quality control [Tanhua et al, 2010]. As a first step, primary quality control is made to identify outliers and obvious errors, which are flagged according to WOCE standard protocol. For the carbonate system, consistency between measured and calculated parameters can be made, provided the carbonate system is over-determined. We show results from a resent cruise to the Mediterranean Sea how this was applied, an ocean basin that is only poorly sampled for the carbonate system. The results of primary quality control for selected cruises will be presented and discussed.

Tanhua et al, Earth Syst. Sci. Data, 2, 35-49, 2010;

Modelled Atmospheric Response to SST Variability in the Gulf Stream Region

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The Gulf Stream follows the US east coast from Florida to Cape Hatteras and then tilts eastwards to the interior of the ocean, resulting in the North Atlantic Current. It is characterized by strong poleward transports of heat by the ocean. The transported warm water masses form a strong contrast to the adjacent colder water and thus lead to the occurrence of strong gradients of the Sea Surface Temperature (SST). Recent studies show that these SST front affects the entire troposphere causing convergences of low level winds, which lead to upward motion of air. Enhanced adiabatic cooling of the moist air and condensation lead to a band of strong precipitation following the SST front.
While previous studies mainly concentrated on the climatological patterns, this study tries to find a connection between the variability of the SST and the atmospheric quantites in this region. While on the high frequencies SST anomalies are mainly controlled by the atmosphere in the midlatitudes, on longer timescales the ocean drives the atmosphere. Since the low frequent ocean variability has a predictable part, a better understanding of the coupling mechanisms between the ocean and the atmosphere might lead to a significant improvement of the atmospheric predictability. This work shows results from experiments using an Atmospheric General Circulation Model with prescribed SST patterns.

Carbonate sediments on Antarctic shelves and implications for a mechanism to buffer Ocean Acidification in the Southern Ocean

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We study the link between rapid acidification and carbonate abundance on the Antarctic shelf and investigate whether and on which regional and temporal scale dissolution of sedimentary carbonates may buffer acidification in the Southern Ocean.
The most important factors, determining the buffering capacity of Southern Ocean carbonates, are the amount of total carbonates in shallow surface sediments and their mineral composition (calcite, aragonite). We analyzed a total of 181 surface sediment samples from different regions of the Antarctic shelf that are archived at various core repositories in Europe and the U.S. In addition, we investigated samples collected during recent expeditions. We measured the carbonate content and the carbonate mineralogy of these sediment samples. The data were supplemented by literature data, amounting to nearly 400 data points. The carbonate content shows clear regional and bathymetric patterns. Two different mechanisms of carbonate preservation related to environmental factors are recognized. One is related to very shallow depths and benthic carbonate producing communities, whereas on the outer shelf currents can lead to accumulation of carbonates in the sand fraction.

Polyphosphate storage in *Beggiatoa alba*

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Recent studies revealed an impact of polyphosphate accumulating bacteria in the sediment on phosphorus sequestration. Phosphate is continuously removed from the pool of biological available phosphorus by phosphogenesis. This reaction results from an oversaturation of phosphate in sediment pore water, which leads to the spontaneous precipitation of phosphorus-rich minerals. Polyphosphate accumulating bacteria are able to release high amounts of phosphate and thereby influence phosphorus sequestration. Although polyphosphate storage is a common feature in many microorganisms, the trigger for storage and its function is often unknown. In this study *Beggiatoa alba* was cultivated in two different organic-rich media and we observed that in one medium they store polyphosphate whereas in the other medium they do not. In order to find out which difference between the media is responsible for absence or presence of polyphosphate inclusions, each difference was tested for it's effect on polyphosphate storage. We observed that high chloride concentrations or the ratio of chloride to calcium and magnesium prevented polyphosphate storage. A similar effect was observed for two lithotrophic, freshwater *Beggiatoa* strains. Polyphosphate storage requires a luxurious phosphate uptake. The uptake of the phosphate anions is coupled to a concurrent uptake of cations like calcium and magnesium. This uptake mechanism seems to be disturbed in the presence of high concentrations of chloride anions compared to calcium and magnesium concentrations. Our results demonstrate that polyphosphate storage is not always a feature which is present or absent in a certain microorganism, but can largely depend on yet unknown factors introduced by the composition of the medium or the environment.

Modeling the carbon cycle in the Paleocene-Eocene Thermal Maximum

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The Paleocene-Eocene Thermal Maximum (PETM; ~55 million years ago) is an adequate analogue in Earth's history regarding to today's climate change. During the PETM, the atmospheric CO2 increased significantly (above ~1000 ppm) over a relatively short time period (~170 kyr).
We investigate the PETM using a fully coupled Earth Sytem Model of the Max Planck Institute for Meteorology (ESM-MPI), which allows to simulate the closed carbon cycle in the oceanic, land and atmospheric compartments and quantifies carbon fluxes between the different reservoirs. Previously the PETM has been addressed mostly with ESM's of intermediate complexity or box models. Therefore, this would be the first attempt to study ocean biogeochemistry in a high CO2 world with an ESM based on general circulation models. By doing this, we aim to get a more detailed representation of the oceanic response to strong CO2 perturbation. In a first step we want to analyse whether a switch in the ocean circulation modified the carbon cycle during the PETM. Given the initial high atmospheric CO2 concentration we investigate the resulting decrease in seawater pH and the associated shoaling of the calcite compensation depth. Finally the timescale of the subsequent gradual recovery will be focused.
As this study is still in its initial stage, first model results available at the time of the conference will be presented. The general setup of the model including the adapted land sea mask of the Paleocene-Eocene continental distribution used in our study will be shown. Additionally, different hypothesis regarding the PETM climate will be discussed.

On the dynamics of Internal Waves in the Ems-Estuary

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Internal waves (IW) are known to be one of the most important factors for vertical mixing of suspended sediments and nutrients in estuaries.
Measurements were taken over two tidal cycles, during a survey in the Ems estuary from September 3rd to 5th 2008. The Ems estuary, which is located the German North Sea Coast, is well known for high sediment loads.
In order to investigate IW generation and evolution as well as their contribution to vertical mixing, different hydro acoustic devices are combined. Suspended sediment concentrations are retrieved from water samples.
Significant wave heights and periods of internal waves propagating on a lutocline are calculated. Wave periods are computed via a Fast Fourier Transformation of lutocline oscillations.
IW generation starts with beginning ebb tide. IW can be still observed on the lutocline, during low slack water.
Different flow behaviour of both water bodies are observed. This suggests that these IW are caused by shear stress across the lutocline.
Three conditions are found for the occurrence of IW breaking which is manifested in local upwelling of sediment. These are great wave heights, high shear stress between both layers and a low thickness of the upper water body.
In this work, new insights in the generation and evolution of IW propagating on a lutocline in the Ems estuary are found. It supports the understanding of the sediment dynamics in estuarine environments.

Impact of Benguela Upwelling (Namibia) - Intensities of the last 10 Ma and Effects on Continental Vegetation

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The Benguela Upwelling System (BUS) is nowadays one of the greatest upwelling regions in the world. It is located along Western Africa and reaches form South Africa up to Angola. In the late Miocene the East Antarctic ice-sheet build-up caused the onset of the BUS by relocating the Polar Front Zone and changing the oceanic circulation patterns (Flower and Kennett 1994; Zachos et al. 2001). Additionally, stronger upwelling and therefore cooler sea-surface temperatures strengthened southeast trade winds (Etourneau et al. 2009) so that the continent is indirectly affected with resulting changes of hydrology and vegetation. A study on marine sediments (ODP Site 1082) showed that the aridification of the South African vegetation was caused by intensification of the BUS during the Late Pliocene (Dupont et al. 2005). In South Africa (ODP Site 1085) the BUS changed the hydrological conditions by strengthening the summer drought during the Late Miocene. The vegetation responded by shifting from a summer to a winter rainfall vegetation (Dupont et al. 2011). To what extent this linkage existed in the more northern located, tropical region is still unknown. Therefore, the current study focuses on tropical marine sediments of ODP Site 1081, offshore Namibia (19°37'S, 11°19'E) to investigate the oceanic conditions and the vegetation changes of the last 10 Ma. The Upwelling intensities are reconstructed by using dinoflagellate abundances and diversities whereas pollen are used to describe vegetation changes. This method will allow a direct land-ocean correlation and will give insights into the hydrological cycle of south-western Africa.

Taking Stock of Global Fisheries Governance, 1950-2010

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While knowledge of the global marine ecological system is far from comprehensive, knowledge of the current state of play of its conjoint social system – the global fisheries governance architecture (GFG) – is lamentable. This paper seeks to improve this by charting the evolution of the overall governance architecture from the relations of relevant actors as a social network. Relevant actors (defined very broadly to include state and non-state actors, and non-organizational institutions), attributes and ties are chosen on theoretical grounds to produce four 'images' of the governance system: political, legal, economic and social. Data is culled largely from FAO databases and complemented with original research. These static pictures are complemented with geocoded and time-stamped data to produce temporal and spatial accounts of the evolution of the global fisheries governance system.
Dynamic social network analysis helps gain leverage on questions of GFG structure, agency and practice across images, space and time. The paper concludes by discussing how the resulting chart informs further research on whether these developments are desirable, what the appropriate response should be, and what is possible given the current context.

Separating natural variability from anthropogenic induced changes: an example from Western Sahel

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The African Sahel is a semiarid ecosystem extremely prone to precipitation fluctuations and therefore one of the most vulnerable regions of the world with respect to changes during the Anthropocene. With our study, we aim at disentangling land-use effects from natural variations during the Late Holocene. We present a record of the past 3100 years from a marine site off Mauritania. Pollen grains are used to reconstruct vegetation changes on the continent whereas the organic-walled dinoflagellate cysts (dinocysts) reflect local oceanographic conditions including terrigenous input. Variations between 1100 BC and 1700 AD are used as a baseline and deviations from this natural variability within the last 300 years are interpreted as anthropogenic influence.
From 1100 BC to ~ 1700 AD pollen and dinocyst associations suggest rather small changes in continental rainfall and terrestrial input. From ~ 1700 AD onward, relative abundances of a dinocyst species typical for agricultultural or industrial activities increase continuously. Its increase coincides with increasing dust and river fluxes recorded at the same core site which have been attributed to the onset of the commercial agriculture in the Sahel by Mulitza et al. (2010).
Within the time-interval of the last 70 years, relative abundances of Savannah pollen as an indicator for more humid conditions decrease after the onset of the Sahel droughts in the 1970s and 1980s. This suggests that the natural hydrological variability in the Sahel region led the vegetation change during that time.

How do volcanoes produce bio-availabe iron: New insights from modeling gas/aerosol-ash interaction inside the hot core of volcanic plumes

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In recent years, the fertilizing potential of volcanic ash has been explored in laboratory experiments, modeling, and satellite studies. Up to now, it has been confirmed that volcanic ash cause natural iron fertilization and phytoplankton blooms in so-called iron limited regions of the ocean. But so far it is unclear which processes inside a volcanic plume transform insoluble iron into soluble, i.e. bio-available iron salts. In this study, we attempt to develop models for the interaction of volcanic gases, ashes and atmospheric gases in the volcanic plume taking into account chemical, physical and thermodynamic properties. Here we present first results for the high temperature region of the plume (>600 K or hot core) which has been simulated using GASWORKS, a solid-liquid-gas equilibrium program. The model is applied to two well studied volcanic eruptions from Hekla and Popocatepetel which, according to laboratory experiments, have low and high fertilizing potential, respectively. First results show that the chemical composition of solid phases and volcanic gases plays an important role in the production of soluble iron salts (e.g. sulphates and chlorides). It is also demonstrated that cooling of the plume via ambient air entrainment significantly affects its composition and results in changes of the redox state of various components (e.g. S and Fe). This phenomenon not only reflects changes in mineral assemblage of the plume (e.g. production of Hematite) but also means the alteration of the gas phase composition (e.g. production of sulphuric acid).

Public Legitimization of Global Climate Politics? A Comparative Study of Media Coverage in 18 Countries

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The UNFCCC-process represents a central attempt to address climate change. Within its framework far-reaching questions are discussed and decided upon. One major challenge is posed by the difficulty to attain legitimacy for both the decision-making process and the resultant policies, mainly attributed to its distance from the citizens of the participating countries.
We will focus on mass media communication on climate change and examine two dimensions of political legitimacy – (1) democratic participation and control (input-legitimation) and (2) positive evaluation of the outcome (output-legitimation). For both dimensions media may act as an important intermediary. They monitor institutions and serve as an arena for opinion formation – thus providing the decision-making process with *input* from the wider society. Furthermore, the media evaluate policies – hence shaping the perception of *output-legitimation*.
Consequently, we will ask to what extent the UNFCCC policy-making is *publicly* legitimated. We will do this on the basis of a quantitative analysis of media coverage on climate change in 18 countries and a qualitative study of a subsample from German and Indian mass media. We will first analyse the input-legitimation dimension by examining to which degree media in different countries monitor the UNFCCC policy and form a transnational discussion arena, by using similar frames of references. For the output-legitimation dimension we examine how decisions are evaluated: to what extent are they perceived as effective, efficient and just?
Our results suggest that the public input-legitimation is of limited degree and that the evaluation of international climate policies diverge widely between countries.

The EU multiannual plan for the Baltic cod stock - A reasonable fishery management option?

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We analyze the multiannual plan for the cod stocks in the Baltic Sea as a part of the European fishery policy against the background of common scientific fishery models. The plan sets up a constant fishing mortality rate of 0.3.to ensure that the Baltic cod stocks can be exploited under sustainable economic, environmental and social conditions. Applying a stochastic stock growth model we compare this EU policy rule with the optimal feedback policies for risk neutral and risk averse fishermen. Using simulation we demonstrate the variation in stock biomass and harvest for these different policy options. Whereas the constant escapement rule for risk neutral fishermen goes along with highly fluctuating harvest rates both the EU policy and the optimal feedback policy for risk averse fishermen guarantee more stable harvest rates over time. Considering different degrees of risk aversion we analyze which degree of risk aversion goes along with the EU policy. We further determine the relative difference in the fishermen's utility between the EU policy and the optimal policy for risk averse and risk neutral fishermen, respectively. We conclude that the EU policy rule of constant fishing mortality rates is a reasonable policy option when assuming mostly risk averse fishermen.

Deep Western Boundary Current observations off Flemish Cap during 2009 - 2011.

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Observations in the subpolar North Atlantic showed significant changes of watermass properties and decreasing Labrador Sea Water production rates throughout the last decades. At the same time altimetry data indicated a weakening of the subpolar gyre through the 1990s. Still, transport time series at the western boundary at 42° N and more recently at 53° N show little or no transport changes and are subject to strong interannual to decadal variability. In summer 2009, a mooring array off Flemish Cap at 47° N was deployed to record current measurements as well as hydrographic properties in the Deep Western Boundary Current regime. The array consists of three moorings and was located over steep topography. The array yielded observations of a very focused and narrow, southward Deep Western Boundary Current. Here we present and discuss the time series of transport and watermass properties from the deployment periods available.

Changes in North Atlantic deep water circulation, 3.3 – 3.0 Ma.

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Changes in deep water circulation in the northeast Atlantic during the most recent Pliocene global warm period from ~3.3 to 3.0 Ma were studied at a suite of IODP/ODP drill sites by using combined stable isotope, ε_{Nd}, and Mg/Ca-based bottom water temperature records. First results show that the Southern Ocean Water may have influenced substantial volumes of the deep North Atlantic reaching depths as shallower as ~2400 m during that time. On longer timescale, a first significant re-organization of the deep circulation in the North Atlantic towards the modern conditions appears to start after ~1.5 Ma. – This study is currently under progress based on further core transects in order to better understand how intermediate-to-deep water masses were distributed, how ocean circulation changed, and in which state the North Atlantic Meridional Overturning Circulation was during this key period of past climate.

Acclimation and adaptation to hypoxia resolved through transcriptional profiling of in situ fixed zooplankton

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Marine invertebrates are exposed to changing, sometimes extreme environmental conditions like low oxygen concentrations in oxygen minimum zones (OMZs), high pressure in the deep sea, low temperatures in polar seas and high temperatures at hydrothermal vents. We developed a strategy to study physiological acclimations to environmental extremes using an *in situ* fixation procedure combined with high-throughput transcriptome sequencing. Bioinformatic analysis of transcriptomes of organisms from different environmental conditions then allows identification of acclimation (and adaptation) mechanisms to the respective conditions. We first compared diapausing copepods (*Calanoides carinatus*) from the Namibian OMZ (low oxygen) with *C. carinatus* specimens sampled at the Ocean surface (high oxygen). This first large scale transcriptome analysis of a marine organism, diapausing at low oxygen provides strong evidence for metabolic reduction, negative regulation of transcription and translation, as well as increased molecular replication and repair in diapausing copepods. Transporter activity, energy-, lipid-, amino acid- and carbohydrate metabolism, as well as digestion are enhanced in active animals. These results are largely consistent with expectations based on published physiological research of *C. carinatus*. Compared to active animals, a strong respiration rate reduction of 80 - 90 % and dominance of catabolic processes were observed for diapausing animals. Our results confirm that *in situ* fixation is a suitable strategy to study acclimations and adaptations to environmental extremes. Further studies on the transcriptome composition of species exclusively thriving within or above the OMZ are underway and their results will be presented during the conference.

Studying heterogeneous monolayer kinetics by quantitative VSFG spectroscopy: The oleic acid - ozone reaction system

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Environmental air-water interfaces are often covered by films of surface-active organic substances. Examples are the marine nanolayer as well as the coated surface of fresh sea-borne aqueous aerosols. These thin films play an important role for air-sea gas exchange and aerosol aging, which is dominated by atmospheric oxidation processes.
Surface-sensitive vibrational sum-frequency generation (VSFG) spectroscopy has been widely used to study the static structure of organic monolayers. In contrast, time-resolved studies of aqueous surface reactions are scarce. In this study, by combining pressure-area-isotherms with corresponding VSFG intensity measurements, quantitative time-resolved signals of the ozonolysis of oleic acid (OA) monolayers were analyzed at the air-water interface.
OA is a favourable benchmark system in atmospheric chemistry for investigating the reactivity of unsaturated organic material. Strongly diverging reactive ozone uptake coefficients γ determined from OA monolayer ($\gamma \sim 10^{-6}$) [1] and OA droplet experiments ($\gamma \sim 10^{-4}$) [2] have been published. We determined accurate surface concentrations based on VSFG by taking into account the 2D phase behavior of the OA monolayer. In disagreement with recent studies, no evidence for significant contributions of surface-active oxidation products were found that may have interfered with our measurements. A simple kinetic analysis yielded an uptake coefficient of $\gamma = 3\text{–}4 \times 10^{-6}$.

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Temporal variability of internal waves in the Deep Western Boundary Current at 16°N

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The relevance assigned to internal waves in the ocean changed significantly during the last decades, evolving from simple noise to an important aspect of ocean dynamics. Breaking internal waves are a significant source of mechanical energy needed for turbulent mixing in the ocean. This mixing leads to a net downward heat and bouyancy transport, thereby maintaining the oceans stratification and closing the energy budget of the thermohaline circulation.
The generation processes and the evolution of internal waves are analyzed in the region of the Deep Western Boundary Current at 16°N in the Atlantic. Shipboard measurements show enhanced vertical mixing in this area. Previous results which indicate a possible dependence of internal wave dissipation on the background velocity make the variable DWBC an excellent study region for internal waves.
Moored temperature and velocity data with very high temporal resolution from the MOVE array, covering the timespan from 2000 to 2005, are analysed to address the dependence of internal wave activity on the strength of the DWBC, tides, stratification, and wind forcing.
The spectra of MOVE timeseries contain dominant spectral contributions from the major tidal constituents as well as from the inertial frequency. Increased internal wave activity especially in the low frequency range can be seen during times of high background velocities. Rotary spectra analyses suggest an internal source of these waves rather than a surface forcing, proposing a generation mechanism which is enhanced by the high velocities in the DWBC.

Investigating oil and gas seepage in the Eastern Black Sea by remote sensing

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Marine hydrocarbon seeps are of manifold interest to researcher of many disciplines because of their relevance as energy source, their potential impact on the global climate and geochemical and biogeochemical cycles. Most marine seeps emit highly climate relevant methane gas to the hydrosphere. To-date it is generally accepted that most of this gas is dissolved in the water column, never reaching the atmosphere. From recent studies there is evidence that at sites where oil is co-occurring with gas, oil forms a protective coating around gas bubbles hindering their complete dissolution. This might provide an efficient mechanism to transport methane to the hydrosphere – atmosphere interface. Here we present first results of a multi-sensor approach to detect and investigate oil and gas seeps in the Eastern Black Sea. Satellite images have been used to locate areas where oil emanating from the seafloor reaches the sea surface. During ship expeditions hydroacoustic techniques were used to detect gas emissions to the water column that are linking seafloor seep structures to their manifestation on the sea surface. Local high resolution mapping with an autonomous underwater vehicle (AUV) and remotely operated vehicle (ROV) in combination with traditional sediment sampling methods help drawing a comprehensive picture of oil seepage in the Black Sea.

Evidence for climate-driven cyclic changes in bottom water ventilation from paleomagnetic, rockmagnetic and geochemical records of Late Pleistocene sediments from the North Pacific

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Deep-sea sediment core SO202-39-3 was recovered at 38°01'N, 164°27'E at a water depth of 5102 m in the Northwest Pacific close to Shatsky Rise. Sediments mainly consist of eolian dust delivered from Asian deserts.
Due to the lack of carbonate and related difficulties in terms of age determination, the North Pacific deep-sea is a rather poor investigated area. Magnetostratigraphy and the relative paleointensity (RPI) of the Earth's magnetic field provide climate independent tools for age determination. Supported by diatom biostratigraphy and tephrochronology, these methods allowed for the development of a reliable age model which reveals, that the 20.23 m sediment column provides a continuous record of the last ~ 950 ka.
Furthemore, the applied methods (rock magnetic, geochemical, sedimentological, etc.) deliver important information about past environmental changes during sediment deposition. In several of the rock magnetic parameters, the effect of reductive diagenesis is clearly visible, whereas the geochemical parameters are not directly affected. Diagenesis seems to occur only in some of the glacials, when fine-grained magnetite was dissolved due to oxygen depletion in bottom waters.
Thus, the magnetic records reflect glacial-interglacial regional variations in the ocean circulation, which might be related even to global circulation changes. The recorded cyclicity also seems to be linked to the Mid-Pleistocene climate transition.

Competition between microbial nitrate reduction processes.

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In the nitrogen cycle two anaerobic respiration pathways compete for nitrate: denitrification and dissimilatory nitrate reduction to ammonia. Denitrifiers reduce nitrate mainly to dinitrogen whereas dissimilatory nitrate reducers produce ammonia. It is generally assumed that relative supply of electron donor (e.g. organic carbon) and acceptor is a major factor responsible for the selection of one or the other pathway. Denitrifiers are assumed to outcompete dissimilatory nitrate reducers if nitrate is supplied in excess. Under nitrate limitation, denitrifiers are expected to be outcompeted by dissimilatory nitrate reducers. The outcome of this competition has important environmental consequences as for example, denitrification leads to a loss of fixed nitrogen from the system.
To investigate the effect of the relative supply of electron donors and acceptors in a natural microbial community, cell extract from sediments of a tidal flat active in nitrogen cycling were incubated in laboratory bioreactors. The experimental conditions only varied between the two bioreactors with respect to the organic carbon to nitrate and nitrite ratio (C/N ratio).
In contrast to the hypothesis, stable denitrifying communities established in the low C/N ratio as well as in the high C/N ratio bioreactor. DNRA was not found to be quantitatively important. Metagenomics will give insight in the microbial community compositions.

Modelling the interannual variability of two key phytoplankton groups

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Traditionally phytoplankton spring blooms in temperate coastal waters are dominated by diatoms. In some areas of the Baltic and North Sea, however, so called cold-water dinoflagellates have become dominant in spring during the past two decades. Although the factors leading to the alternations between diatoms and dinoflagellates are not fully understood, it has been proposed that the life cycles of the respective species play an important role in governing the phytoplankton composition. In order to study the interannual variability in phytoplankton composition, we have developed a numerical model that includes the life cycles of both phytoplankton groups. For the dinoflagellate life cycle four life cycle stages are considered: growing vegetative cells, gametes, sinking resting cysts, and rising germinating cells. The transitions between these life cycle stages are assumed to be a function of external and endogenous factors. The diatom life cycle distinguishes two different life cycle stages: growing and resting stages; the life cycle transitions are assumed to depend on external factors only. Both life cycles are coupled to a water column model, which is set up to the Baltic Sea. Our model results indicate that the growth conditions during the life cycle strongly affect the initial concentrations in the follwing spring. The size of the initial concentrations in spring determines in turn whether dinoflagellates or diatoms dominate.
In addition, the model results suggest a strong the year-to-year fluctuations of dinoflagellate and diatom abundance.

NW African precipitation history of the last glacial cycle: a δD record of dust-hosted plant waxes

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The purpose of this study is to decipher rainfall variability over NW Africa in relation to oceanic changes during the last glacial cycle (last 120 ka). Previous studies infer humidity changes from vegetation type changes and dust fluxes, but so far, continental palaeo-hydrologic conditions have not been assessed directly. Therefore, we apply a molecular isotopic approach by using hydrogen (δD), as well as stable carbon isotope analyses on terrestrial plant waxes. These compounds were extracted from deep-sea sediments, cored off Mauritania at ODP Site 659. This site is located below the tracks of the African Easterly Jet and the Northeast Trade Winds, well suited to record environmental shifts of the Sahara/Sahel transition.
The δD of plant-wax-derived *n*-alkanes is analysed as proxy for past rainfall variability, whereas accumulation rates of these compounds can provide information on vegetation density and aeolian transport strength. Sea-surface temperatures (SST) are estimated by using the $U^{k'}_{37}$ Index of alkenones to correlate continental climate with SST. In a further step, the $\delta^{13}C$ of *n*-alkanes will be analysed to reconstruct variations in vegetation composition (C3/C4 plants). In a synthesis, our results will be compared with palynological data and with existing records of both deep-ocean circulation changes, reflected in the $\delta^{13}C$ signature of benthic foraminifers, and dust fluxes covering this time-interval. In this way, we aim for a better understanding of the NW African hydrological cycle, its relation to SST and Atlantic circulation changes, as well as to identify potential feedbacks between hydrology, vegetation changes and dust export.

Improved Modelling of Sea-Level Patterns by Incorporating Self-Attraction and Loading

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We implement the effects of gravitational self-attraction and loading (SAL) into a global baroclinic ocean circulation model and investigate effects on sea-level patterns, ocean circulation, and density distributions. We compute SAL modifications as an additional force on the water masses at every time step by decomposing the field of ocean bottom-pressure anomalies into spherical-harmonic functions and then applying Love numbers to account for the elastic properties of the solid Earth. We show that considering SAL in the post-processing is insufficient, especially in coastal waters, where SAL modifies local sea level by almost 1 cm on average. Modifications of water velocities as well as of heat and salt distributions are modelled as well, yet they are small. Simple parameterizations of SAL effects currently used in a number of ocean circulation models suffer from the process's inhomogeneity in space and time. We find that these parameterizations improve the modelled sea-level patterns, but fail to reproduce SAL impacts on circulation and density distributions. We therefore recommend increased efforts to consider SAL in ocean circulation models in a computationally efficient way.

Reducing cache misses on tetrahedral meshes by intelligent element numbering

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Adaptivity is widely used with finite element, finite volume and discontinuous galerkin (DG) methods for solving partial differential equations numerically.

All of these methods need an underlying mesh consisting of several elements. We show the element numbering's in fluence on computation time and approach towards an efficient element numbering strategy for adaptive meshes.

Spatial adaptivity means a local refinement, respectively coarsening of the mesh. Therefore, elements are often inserted to or deleted from the mesh. For our purposes we use amatos, a library for adaptive grid management developed by Jörn Behrens and others.

amatos indexes the elements by the space filling curve (SFC) approach.

This approach induces an element numbering which reflects the mesh topology: two consecutively numbered elements have a common edge. This neighborship preservation leads to a partitioning of the domain which can be used for parallelization.

Moreover, the SFC- approach speeds computations up on a single processor, if the data needed is stored in a SFC-ordered sequence. Then data located 'near' in memory belongs to neighboring elements of the mesh. This leads to less cache misses for computations involving those elements, for example flux calculation in DG-methods.

The techniques above are established for triangular grids and are used by the two-dimensional version of amatos. Although tetrahedral mesh refinement is similar to the triangular case, a SFC-order is not induced by the refinement algorithm. But the resulting order has some promising properties. We show that the chosen order of elements reduces the cache misses significantly.

Transport of suspended matter in the form of turbidity clouds in the Elbe Estuary

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In the tidal environment transport of suspended matter is, at times, observed to occur in distinct clouds of sediment, visibly distinguishable at the surface from the surrounding clearer water. Previous studies have linked the formation of high sediment concentration clouds with upward suspension events due to turbulence in the bottom boundary layer. In this study, we aim at a further understanding and quantification of the intermittent nature and processes behind cloud formation. A sampling campaign was carried out in the Elbe Estuary combining various optical and hydro-acoustic measuring techniques. The data comprise high-frequency time series of velocity and suspended sediment concentration over several tidal cycles. At this location, clouds were observed at the beginning of the accelerating tides (10 m in diameter, period of 8-20 s) and merged to form even larger clouds as the flow accelerated further until there was an almost homogenous sediment mixture. Around slack water the suspended material settled towards the sea floor. When passing the sensors, the clouds manifested by an increase of suspended sediment concentration (from 100 mg/l to 300 mg/l) and a slight decrease in temperature (up to 1°C), a possible indication of the upward transfer of colder water masses by ejection events. Turbulence analysis of boundary layer velocity measurements showed distinct burst events at the stoss-side of seabed dunes and increased turbulence intensity in the entire water column above. These flow structures are revealed as turbidity clouds on the sea surface that are consecutively advected with the ambient current.

Are Holocene climate events irrelevant for, or are they triggers of first agriculture in central and northern Europe?

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First farming communities established in Europe between 7000 BC and 3000 BC; a clear spatiotemporal trend from older southeastern to younger northwestern sites can be found in archaeological dates. The process, however, and the triggers of the regional Neolithic transitions are unknown or at the least heavily debated. Most probably, European early agriculture was allochtonous and introduced from the Near East and Anatolia; but were it people who moved and outplaced the indigenous hunter-gatherer groups or admixed with them? Or, was it just material and information that moved---the ``Neolithic Package''---consisting of domesticated plants and animals and the knowledge of its use? What triggered the northwestward expansion and what controlled its timing and pacing? Extreme climate events during the Holocene have been suggested as causal factors for, e.g., migration waves. I show with the Global Land Use and technological Evolution Simulator (GLUES)---a socio-technological model for regional potential population and innovation---a consistent explanation of the European Neolithic. I identify regions where the onset of agriculture was insensitive to climate variability as seen in a database of globally 130 high-resolution climate proxies. I quantify migration and information flows between all regions which form part of the European Neolithic and demonstrate the importance of cultural diffusion for Northern Europe. At the same time, the timing of the regional transitions, foremost the lag between Linear Pottery (central Europe) and Funnel Beaker (Baltic and North Sea coast) cultures can be best explained when climate variability is taken into account. I conclude that climate variability mediates, but does not trigger or cause, the Neolithic transition in Europe.

A study of diapycnal mixing in the North Atlantic

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The North Atlantic is one of the main locations of deep water formation. In the area between 42° and 62°N, deep water is formed and transformed, providing dense abyssal water masses, maintaining the oceanic stratification and support the Atlantic Meridiornal Overturning Circulation (AMOC).
Six cross-Atlantic large-scale hydrographic surveys were carried out during the years 2003-2010 with combined CTD/LADCP measurements. Turbulent diffusivity K_ρ is then estimated from the energy dissipation rate, which is inferred from parameterization of horizontal velocity and strain of the density field. Observational data are analyzed to get an overview of the regional variability in the strength of the mixing and to identify the dependencies of K_ρ. Analysis of these hydrographic observations shows that mean value of diffusivity in the open ocean is 6.8×10^{-5} m^2s^{-1}, higher values are found in the area of the Deep Western Boundary Current and over rough topography, where they can exceed 10^{-3} m^2s^{-1}. An increasing trend of K_ρ is found with the increase of the variation of bottom surface height. Mixing is enhanced in the area with rough topography, and high values can reach to hundreds or even thousands meters above the bottom of ocean.

The impacts of climate change on societal stability: modelling of complex systems

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The consequences of climate change are complex, as they can affect society directly and indirectly. Indirect impacts can diffuse in the complex network of causal chains that link environmental conditions, resource availability, human wellbeing and social stability.
Direct implications of more frequent extreme events such as droughts, floods, or storms can cause and exacerbate already existing stresses on societies. Social cascades triggered by environmental events can result in strong political changes as can be observed in the case of the impacts of the catastrophic earthquake in Japan on German nuclear policy. Migration dynamics can change social structures on various levels of society. A prominent example for political changes triggered by mass movements is the Arabian Spring.
In order to be able to assess the possible consequences of climate change or other cataclysmic events on societal stability, it is necessary to devise a modelling framework that encompasses key relationships and dynamics of the causal chains mentioned above. Central to the social dynamics are the actions of the actors involved. Therefore, agent based modelling is an appropriate tool to address the complex of human-environment-interaction.
Exemplarily, simulations can be conducted for climate security hot spots such as the water allocation conflicts in the Nile River Basin.

Hydroclimatologic variability in the Tropics during Termination 1 and the Holocene

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The tropical eastern Pacific is a key area for monitoring climate variability, as it is highly sensitive to ITCZ
(Intertropical Convergence Zone) and ENSO (El Niño-Southern Oscillation) dynamics. A sequence of new sediment cores from high deposition rate locations along the Colombian and Panamanian margins thus provides an opportunity to improve our understanding of the role of the tropical hydrological cycle as a potential driving force for global climate change. The proxy studies will be accompanied by simulations of Holocene and deglacial climate states, using a high-resolution version of the comprehensive climate model CCSM3. The model results will help to interpret the proxy records and
to set them into a global dynamical context. In particular, the model will provide quantitative information about changes in the Atlantic-to-Pacific water vapor flux, while the proxy records will be indispensable for verifying the model output.

Success of the new phytoplankton species *Mediopyxis heleysia* in the North Sea

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The diatom *Mediopyxis helysia* was recently described to science from clones found in 2003 in the North Sea, Wadden Sea, and the Gulf of Maine. We observed that seven years after it's first occurrence, *Mediopyxis helysia* contributed to about one third of the biovolume of a phytoplankton spring bloom in the western Wadden Sea. Microzooplankton grazing experiments based on the dilution technique could not measure any grazing impact on the natural phytoplankton community. Our results suggest that protection against grazing might enhance the rapid spread of *Mediopyxis helysia,* and furthermore, that this new diatom has the potential to become a dominant species in the western European seas.

Trade-cumuli statistics compiled from cloud radar measurements on Barbados

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Numerous studies show, that a better understanding of clouds in climate models is a key element to reduce the uncertainty in model based predictions of climate sensitivity. Especially, low-level clouds contribute significantly to the cloud climate feedback. By observing them in a more detailed way over a longer time interval and in a well characterized environment we hope to improve our understanding of factors that regulate their properties and improve their representation in large-scale models.
Within our ongoing field campaign on Barbados a scanning K-band cloud radar is employed to observe trade-cumuli clouds arriving upstream from the Atlantic. The uniqueness of having various cloud radar scans in different elevation angles giving us two advantages compared to an only vertical pointing system. First, we are able to observe clouds which are not perturbed from heat or moisture fluxes coming from the island and ,second, we are able to sample more clouds for establishing a robust statistical database. This long-term utilization of a scanning cloud radar for about two years was never done before in this kind of cloud-regime.
The focus of this study lies on identifying structural and organizational patterns of the clouds rather than their microphysical properties. We will show statistical results derived from our measurements with the scanning cloud radar. To give more insights about the distribution and intensity of shallow cumuli clouds we will present how reflectivity patterns can vary with altitude. Also, we show if and how cloudiness changes for different temporal seasons.

Southern Hemisphere climate response to an extremely large volcanic eruption

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Large volcanic eruptions have a significant impact on global climate especially if they erupt in the tropics. The direct injection of sulfur into the stratosphere and the subsequent conversion to volcanic sulfate aerosols lead to a strong global radiative impact lasting up to several years due to residence time and poleward transport of these aerosols by the large-scale meridional overturning circulation in the stratosphere.
Evaluating the climate response to the extremely large volcanic eruption (VEI>7) of Los Chocoyos (Guatemala 84 ka BP) is based on petrological estimated sulfur emissions. We calculate the volcanic aerosol evolution through simulations with the aerosol circulation model MAECHAM5-HAM including detailed microphysics, taking the volcanic aerosol size distribution and effective radius into account. Using the resulting aerosol optical depth distribution, ensemble simulations are carried out with the complex MPI Earth System Model (ESM), simulating the interaction between atmosphere, ocean, sea ice, carbon cycle and vegetation. This work is concentrated on the interplay between atmospheric, ocean and sea ice changes over the Southern Hemisphere, which are generated by complex relationships between the radiative forcing and dynamical changes in the climate system on different time scales. Results show a positive Southern Annual Mode for at least 12 months after the eruption accompanied by atmospheric (e.g., temperature, precipitation, wind circulation), as well as oceanic (e.g., ocean heat content, sea ice, barotropic streamfunction) changes for several years and decades, respectively. The full complexity of the ESM allows a better investigation of climate impacts and feedbacks after extremely large volcanic eruptions.

Geochemical processes in sediments of the German license area for polymetallic nodule exploration in the NE Pacific Ocean.

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During RV Sonne cruise SO-205 to the eastern part of the German manganese nodule exploration area in the Pacific Ocean, we recovered sediments with a multiple corer and a box corer at 14 sites and with piston and gravity corers at 7 sites. These samples were geochemically analyzed to elucidate whether diagenetic processes contribute to manganese nodules growth.
Manganese nodule abundance was determined from box core samples. The sediments recovered with a piston-/gravity corer at the same sites show neither dissolved Mn^{2+} in pore waters nor denitrification in sediments from sites with medium to high manganese nodule abundance. In contrary, sediments from nearby locations with low manganese nodule abundance show an increase of pore water [Mn^{2+}] with depth and denitrification. This result suggests that there is no diffusive flux of Mn^{2+} from underlying sediments to manganese nodules at the surface. Furthermore we propose that these small scaled regional differences in the geochemical characteristics of sediments can be explained with variations in sedimentation rates and organic matter input.

Loop Current variability due to wind stress and reduced sea level during the Last Glacial Maximum (LGM)

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One of the most prominent features of the circulation in the Gulf of Mexico is the Loop Current (LC). Especially the shedding of anticyclonic eddies from the LC is of interest as it supplies heat and moisture into the northern Gulf on the one hand and via the Gulf Stream from low latitudes (subtropics) towards high latitudes on the other hand. For the assessment of the impact of LGM wind stress (see PMIP-II database) and reduced sea level we have re-configured an existing hierarchy of models of the North Atlantic Ocean (FLAME) with increasing horizontal grid resolution (ca.30 km). The sea level was lowered (compared to the present-day simulation) by 67 m and 110 m. These sea level changes have been chosen according to the cold-deglacial Heinrich I period and the Younger Dryas.

The result of our model simulations is a continuous increase in eddy shedding from the LGM to the Holocene. This increase is predominantly controlled by the continuous deglacial sea level rise. Changes in wind stress curl related to the northward propagation of the ITCZ tend to produce larger Yucatan and Florida Strait through-flow but do not play a dominant role in controlling the eddy shedding, and thus appear of minor importance for the regional climate in the Gulf of Mexico.

Leaf leaching of dissolved organic carbon from eight plant species in the mangrove-fringed Segara Anakan Lagoon, Java, Indonesia.

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Leaching experiments with eight plant species were performed in the mangrove-fringed Segara Anakan Lagoon, Java, Indonesia. The leaching rates of dissolved organic carbon (DOC) were determined at salinity concentrations of 0, 10, 20 and 30 over a period of 30 days for *Acanthus ilicifolius, Aegiceras corniculatum, Avicennia marina, Bruguiera gymnorrhiza, Ceriops tagal, Derris trifoliata, Rhizophora apiculata* and *Sonneratia caseolaris*. Salinity had little influence on the leaching. Only for *A. corniculatum* and *S. caseolaris* DOC concentrations were higher in freshwater than in saline water. Highest DOC concentrations were detected for *A. ilicifolius* and *A. marina* with up to 115.1 and 53.6 mM g^{-1} dry weight, respectively, and lowest for *B. gymnorrhiza* with up to 4.1 mM g^{-1} dry weight. A decrease in the DOC concentrations for all species except for *B. gymnorrhiza* was observed after between seven and 15 days of the experiment. Large species-specific variations were observed and leaching concentrations differed by more than one order of magnitude. *A. corniculatum, Nypa fructicans* and *R. apiculata* were dominant tree species in the eastern part of the lagoon, whereas *Avicennia alba, A. corniculatum* and *S. caseolaris* dominated the central part. The vegetation changed within the last 25 years due to logging, so that today in most areas the shrub *A. ilicifolius* dominate the plant community. A shift in vegetation due to logging might lead to an increase in the DOC inventory and element cycling in the lagoon. This, in turn, could promote microbial activity and lead to shifts in food web structures.

Tracing the Holocene impact of the La Plata River over the S Brazilian shelf

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The La Plata River basin is the second largest drainage basin in South America, and its discharge to the western South Atlantic is strongly influenced by the South American Monsoon System. Depositional processes in the southern Brazilian shelf are related to the northward penetration of shelf waters associated with the La Plata River plume. This study aims to reconstruct the paleoenvironmental changes that occurred in the southern Brazilian shelf during the last 7000 years by applying sedimentological (grain size) and geochemical (bulk sediment elemental ratios, Fe/Ca and Ti/Ca - proxies for terrigenous input and Ba/Ca and Ba/Sc - proxies for paleoproductivity) proxies in two marine sedimentary records (core 7605 - 27.104º–S, 47.804º–W/water depth: 93 m; and core 7616 25.098º–S, 45.644º–W/water depth: 100 m). Grain size and geochemical data highlight the occurrence of important changes in the depositional processes on the southern Brazilian shelf, probably related to changes in the source of the sediments–. From 2000 cal years—B.P. towards the Present significant increases in the mud contents and in the Fe/Ca, Ti/Ca and Ba/Sc ratios, point to a progressively higher influence of the Plata Plume Water in the shelf system. This is consistent with–a scenario of relatively more humid conditions in southeastern South America due to the southward displacement of the Intertropical Convergence Zone and the intensification of the South American Monsoon System that took place throughout the Mid to the Late Holocene.

Modelling the Arctic hydrologic cycle

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Anthropogenic climate change causes strong warming leading to increased moisture transport northward to high latitudes and thus increased freshwater input into the Arctic Ocean.
Several global general circulation models show remarkable differences in their response to such an increase in freshwater input. Some models simulate an increasing export, while others show an almost constant total freshwater export, but an increase in the storage of freshwater within the Arctic Ocean.
One main uncertainty of such a global general circulation model is due to the resolution, which is too coarse to resolve adequately small scale processes and complex topography such as the Canadian archipelago.
To be able to model the important aspects of the hydrologic cycle in the Arctic region, we set up the primitive equation global general circulation model MPI-OM with rotated poles (leading to high resolution in the region of interest) and couple it with the regional atmospheric general circulation model REMO covering the full catchment area of the Arctic rivers. Additionally, we include a discharge model providing lateral terrestrial waterflows.
We validate the relevant processes for the hydrologic cycle of the Arctic with reanalysis and measured data. Results of the hydrological discharge model are analyzed with respect to climatologies and changes within the seasonal cycle. Comparison with output from a global model (MPI-OM/ECHAM) shows an improvement in the components of the freshwater budget, most obvious in the transport through the Canadian archipelago as well as in the seasonal cycle of sea ice.

Docosahexaeonic acid (DHA) affects nutritional condition of larval herring in the field

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Several omega-3- and omega-6-fatty acids promote growth and health not only in human beings, but some of them are also essential for development and growth of marine organisms. These fatty acids are synthesised mainly by phytoplankton but also by protists and travel via pelagic crustaceans up the food chain to fish as well as fish larvae. Especially in the highly sensitive early life stages 2 omega-3-fatty acids (DHA and EPA) seem to play an outstanding role for development. For instance, poor supply of them has shown to negatively affect the development of cerebral structures. To investigate effects of fatty acids on larval herring growth we collected seston, potential prey and larval herring during times of two contrasting environmental situations in the Kiel Canal in spring 2009. Along with biotic and abiotic background data we analysed fatty acids in seston, potential prey organisms and in the larvae as well as the nutritional condition of the larvae as the response variable. Even though a DHA poor phytoplankton class dominated the phytoplankton community, high concentrations of DHA were found in the seston samples, indicating trophic upgrading by protists. Seston DHA was tightly coupled to DHA of early larval herring stages, and this relationship ceased with herring size. Larger larvae always had higher DHA concentrations, and DHA concentrations in the larvae were positively related to the nutritional condition of the larvae. The latter gives support to the current assumption about the crucial role of DHA in larval fish development, even in the field.

Sedimentary pattern on the northern Argentine slope: the impact of North Atlantic Deep Water on southern hemisphere slope architecture

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Several major contourite drifts were studied off Northern Argentina to determine their evolutionary stages as well as to identify and assess the possible impact of Northern Source Deep Water (NSDW) on the middle slope architecture. Based on their sedimentary stacking pattern, current controlled sediments deposited beneath the northern extent of the Ewing Terrace allow inferring on the pale-oceanographic setting of the last 32 Ma.
First current controlled sedimentation can be observed close to the Eocene/Oligocene boundary. As a result of the opening of the Drake Passage and its related global cooling, surface, intermediate and deep ocean currents in the Southern Ocean strengthened and allowed the first time sediment deposition off Argentina under current control. During the Mid-Miocene climatic optimum the NSDW had a first impact on the southern hemisphere, leading to a major oceanographic rearrangement and the formation of a large plastered drift. Above, the continuous strengthening of NSDW until the closure of the Central American Seaway (CAS) along the middle/lower slope off Argentina led to the modern extent of the Ewing Terrace. Today, after the complete closure of the CAS and under the influence of the full force of the NSDW, new plastered drift sequences are built upon the Ewing Terrace.

The new "macro-regional cooperation concept" and the EU Strategy for the Baltic Sea Region.

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In 2009 the European Union adopted a strategy for the Baltic Sea region in order to solve several problems such as the critical environmental situation, infrastructural accessibility, and economic disparities. This target should be achieved by a more effective cooperation between different policy areas allocated on different regulatory levels. Using the existing cooperation structure between the European Member States, which are bordered on the Baltic Sea, a new "macro-regional cooperation concept" should be realised in practise. In the future successful implementation of the strategy should contribute to a balance between the utilization and the conservation of the sea.
The novelty of the "macro-regional cooperation concept" is to look at the Baltic region as a singular entity with one common cooperation scheme, which should incorporate different policy fields in order to achieve a sustainable development for the macro-region. The new integrated concept of cooperation is the key approach for my PhD project. In the first step of the working progress relevant preconditions of the successful implementation of the EU concept should be derived. First, a general model of the preconditions based on the European recommendations will be described. Second, a practical implementation of the cooperation concept should be tested for the Pomeranian Bight by means of a comparative analysis of regulatory procedures and cooperation practices within two selected policy fields (nature conservation and off-shore wind power). During the upcoming conference in October 2011 a preliminary result of the first analytical step will be presented.

Sustained observations of the North Atlantic Current.

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The subpolar gyre of the North Atlantic Ocean is a crucial component for the climate relevant oceanic circulation. Warm and saline water from the subtropics enter the subpolar and polar regions, and subsequently return as the deep and cold limb of the Atlantic Meridional Overturning Circulation (AMOC). Model simulations show a relation between deep water formation, the strength of the subpolar gyre and the intensity of the AMOC.
To observe the position and the transport variability of the North Atlantic Current (NAC), thus the strength of the subpolar gyre, an array of four inverted echo sounders equipped with bottom pressure sensors (PIES) is deployed along the Mid Atlantic Ridge between 47° and 53°N since August 2006. The location of the PIES allows the separation of the main NAC pathways through the fracture zones and a comparison with satellite altimetry data.
PIES are perfectly suited to perform sustained observations. They are build for minimum energy consumption and with the possibility to transmit data via acoustics. Two of the PIES were deployed successfully for four years with multiple acoustic read out of the data. An advantage of the PIES is, that they need not be serviced every year, saving on ship cost. Further, the long continuous time series help to avoid problems with the drift of the pressure sensors.
Using a transfer function, based on hydrographic profiles from CTD and Argo measurements, along with the measured vertical acoustic travel time, time series of temperature and salinity profiles are determined. Based on the density gradient and in combination with the pressure variations, the baroclinic and barothropic transport variations are calculated.

Melt ponds on Arctic sea ice determined from MODIS satellite data

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The appearance of melt ponds in Arctic summer on sea ice reduces strongly the surface albedo and accelerates the decay of Arctic sea ice. There is an ongoing debate of the impact of the ice-albedo feedback for the Arctic amplification.
Due to different spectral properties of snow, ice, and water multispectral sensors like MODIS are applicable for the analysis of the distribution of melt ponds.
For the analysis of MODIS data, we apply an artificial neural network to determine the melt pond fraction from mosaics of the entire Arctic region. To train the neural network we use a melt pond dataset with 3 surface types: snow and ice, open water, and melt ponds. This dataset is also generated from MODIS data by a spectral unmixing algorithm, taking the fact of the different spectral reflectances of the used surface features in the shortwave spectrum.
The advantage of our trained neural network over the spectral unmixing algorithm is a comparatively fast analysis of large datasets with a high accuracy. This allows us to calculate for the first time a data set for the spatial distribution of melt ponds for the entire Arctic region. From the availability of MODIS data from 2000 until now, we are able to process seasonal cycles for the last 11 years.
The validation of the melt pond dataset was done with aerial photos from the MELTEX campaign 2008 in the Beaufort Sea and the data sets from the National Snow and Ice Data Center for 2000 and 2001 of four sites spreaded over the entire Arctic.

Clues to scaling from a field site to a region: lessons from a peatland-forest mire in northeast Russia.

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Field-based research work carries the burden of demonstrating scalable process information to the regional and global climate modelling community. Recent interest in the role of boreal-region peatlands to the global carbon cycle and regional hydrology highlights the need for concise descriptions of dominant controls on carbon export, hydrological interactions, and ecological behaviour. In this talk we focus on scalable lessons learned from our peatlands field research site in northeast Russia. We study three partially-nested spatial delineations – a peatland, its surrounding forests, and a regional river draining a forest-peat catchment – and how these zones behave during the spring snowmelt and associated flush of organic matter. In particular, we demonstrate the importance of the site's edge-region, where the peatland meets the surrounding forest and mineral soils. Our findings indicate that dissolved carbon moves through the region in an interesting and complex manner, and not always in parallel with other dissolved constituents, such as electrical conductivity. The conclusions of this work and their implications for understanding the local and regional carbon cycle include the following: (1) lag times exist between maximum flow and/or DOC concentrations in different water bodies and are determined by hydrological process controls rather than by DOC-release; (2) the connectivity and sources of water contributing to outflow discharge pathways may determine the magnitude of interactions between different ecological regions (i.e., peatlands and forests). It is expected that these findings will have implications for the application of regional and global models that incorporate structural representations of peatland dynamics.

Pacific sector of the Southern Ocean coccolithophores and their paleoceanographic significance

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This study provides a basin wide comparison and an extensive analysis within the pelagic ecosystem focused on fitoplankton and specifically coccolithophores in the Pacific Sector of the Southern Ocean (SO).
One of the main ocean primary producers are coccolithophores. These marine unicellular, flagellated and autotroph algae belongs to the division Haptophyta and the class Prymnesiophyceae. They are among the main components of phytoplankton in the present-day ocean and they show a broad distribution, from sub-polar to equatorial waters. Coccolithophores are responsible for about one half of the total carbonate production in the ocean and play an important role in marine biogeochemistry influencing Earth's climate system through two basic mechanisms: the biological, and the physical pump. Coccolithophores may be responding to recent oceanographic changes such as temperature, salinity and stratification rather than changing ocean carbonate chemistry.
The main goal of this work relies on the analysis of the present-day coccolithophore (living) assemblages from Pacific sector of the SO. All the samples were collected during expeditions ANT-XXVI (Punta Arenas, Chile-Wellington, New Zealand) from 27/11/2009 to 27/01/2010 and during 213 SOPATRA (Valparaiso, Chile-Wellington, New Zealand) from 27/12/2010 to 08/03/2011.
For the study of coccolithophore assemblages, 2-3 liter water column samples were collected using the membrane pump and CTD casts (4-6 samples from the upper 200 m) and were filtered through cellulose membranes, with 0.45 µm pore size on board german Research Vessels *Polastern* and *Sonne*. Once on land, coccolithophore assemblages were examined under Scanning Electron Microscope (SEM).

Accumulation variability in West Antarctica related to ENSO from satellite gravimetry

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Interannual ice-mass variations along the Antarctic Peninsula (AP) and in the Amundsen Sea Sector (AS) are obtained for the years 2002 until 2009 using satellite data of the Gravity Recovery and Climate Experiment (GRACE). The GRACE signals correlate well (r~0.7) with accumulation variations based on the net precipitation from the European Centre for Medium-Range Weather Forecasts (ECMWF). Moreover, mass signals for AP and AS are anti-correlated in time (r~-0.4) and contain El Niño Southern Oscillation (ENSO) signatures related to the strength of the Amundsen Sea low-pressure system, that has a dominant influence on West Antarctic atmospheric moisture transports. The GRACE interannual mass variations are significant compared to the mean annual mass loss of -110 ± 7 Gt/year in coastal West Antarctica.

Scale (in)dependency of statistical cloud cover parametrizations

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Clouds play a major role in weather and climate and it is therefore crucial for numerical models to appropriately represent clouds in the atmospheric system. Especially the cloud cover is of high importance to calculate the earth's radiation budget. But still different parametrizations and the lack of understanding of clouds are known to be amongst the main reasons for uncertainties in global climate simulations so far. Novel statistical parametrizations represent the subgrid scale variability of e.g. total water mixing ratio with a probability density function and could improve the calculation of cloud cover.

As the new model generation offers the opportunity to use local grid refinement, another problem appears. The need grows for parametrizations which automatically adapt to changing resolutions and are not fixed or tuned to one special resolution. Statistical parametrizations for cloud cover have a great potential to fulfill this request. As the equations for the higher distribution moments are prognostic the question arises how we expect them to behave on different scales: How should variance and skewness change? And should they change at all? We try to answer these questions with an evaluation of data from high resolution models (COSMO-DE) and known theory.

In the end this new knowledge about the theoretical expected behaviour of the moments under different resolutions can be used to improve the prognostic equations in a statistical scheme in order to build a scale adaptive parametrization for the cloud cover and improve the representation of clouds in numerical models.

Modelling the Implications of Climate Change for European Freshwater Wetland Distributions

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In Europe wetlands have been drained and converted for centuries. The remaining wetlands are fragmented and often in a degraded state. During the last years efforts have been made to restore and preserve wetlands for various purposes, because wetlands provide crucial services and functions. They affect the carbon, water, and nitrogen cycles, serve as habitat for many plant and animal species, and act both as sink and source of greenhouse gases. In this sense, wetlands, its functions, and spatial extension may also be of significance in global and regional climate modeling. A fully coupled wetland-climate model under consideration of land use has not yet been developed; and within earth system models, wetlands are included as static shape with fixed boundaries. Wetlands have also received little attention in large-scale economic models of land use. But with relatively high European political ambitions for climate change mitigation, biodiversity protection, energy, water, food, and civil security, the question arises how to optimally govern wetlands in order to maximize market and non-market benefits. Qualitative and quantitative data on wetland ecosystems, its functions and services are required as base input for such model approaches. But often these studies are hindered by a lack of knowledge on wetland ecosystem functions, processes, as well as its spatial and temporal distribution under changing conditions. This study aims to contribute to fill these gaps by evaluating the preservation potentials of freshwater wetlands in Europe under consideration of climate change.

Response of a flagellate dominated plankton community to artificial iron enrichment in the Southern Ocean

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Several in-situ iron fertilization experiments have been carried out thus far in the Southern Ocean in order to investigate the role of iron limitation in explaining the low productivity of this HNLC (High Nutrient Low Chlorophyll) area. The Indo-German iron fertilization experiment LOHAFEX (Loha is the Hindi word for iron, and Fex stands for Fertilization EXperiment) was carried out in the Atlantic sector of the Southern Ocean. The aim of my study was to investigate the response of the phytoplankton assemblage to iron addition with both microscopic as well as molecular techniques. The initial phytoplankton community was characterized by a diverse flagellate assemblage dominated by members of the prymnesiophytes and prasinophytes. The phytoplankton community of mixed flagellates responded rapidly to the iron addition by increasing Fv/Fm ratios above 0.4 and chlorophyll concentrations in the 60 m layer doubled to 1.5 mg Chl *a* m^{-3} within two weeks but stopped increasing thereafter, although rates of primary production remained high (> 1.0 g C m^{-2} d^{-1}). The stagnation of biomass build-up after about two weeks despite continuous growth was the result of trophic cascading effects that channeled most of the primary production to higher trophic levels. Our results thus indicate that flagellate dominated communities respond differently to iron addition than diatom dominated ones with important implications for the functioning of pelagic ecosystems and the carbon cycle.

Impact of alkalinity fluxes on the carbon cycle in the southern North Sea

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Rising atmospheric and oceanic CO_2 concentrations cause an ongoing acidification of the marine environment. The nearshore effects of acidification are difficult to determine, because of the shallow water column and the tight coupling to the benthic environment. As a result of enhanced biogeochemical processes, seasonal pH-variations in coastal- and shelf regions can be up to an order of magnitude higher than in the open ocean and potentially mask the interannual trend of decreasing pH. Total Alkalinity (TA) is an essential part of the carbonate system and hence vital to understand and reliably attribute these observed pH variations.
Studying the TA-variations requires precise estimations of TA–fluxes. The latter depend on physical, chemical and biological processes. For budgeting TA in the southern North Sea we applied the ecosystem model ECOHAM with a prognostic treatment of TA and the corresponding TA-fluxes for the years 1977 - 2009. Dissolution of $CaCO_3$, the release of ammonium into the water column and the uptake of nitrate are processes that increase TA. Vice versa, $CaCO_3$ formation, uptake of ammonium and the release of nitrate reduce TA.
In our three-dimensional model-study we investigate two different sources of TA, riverine input and atmospheric nitrogen deposition. We quantify their contributions to TA within the southern North Sea and compare them to internal processes in the water column. We finally found out that the exchange between Wadden Sea and southern North Sea plays a central role in understanding seasonal variations in TA concentration and consequently pH.

Phytoplankton species shifts affect upper ocean dynamics through biological-physical feedback mechanisms.

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Biologically induced changes in physical oceanic properties through phytoplankton provide potential positive and negative feedback loops. In particular, surface floating cyanobacteria, which are expected to be favored from future environmental conditions and can form large surface mats, can increase light absorption and the surface albedo and decrease momentum input from the atmosphere by wind. Increased light absorption and decreased momentum input will enhance sea surface temperature and stratification favoring the growth of nitrogen-fixing, buoyant cyanobacteria. Thus, these organisms can gain from their own presence. In contrast, increased albedo will lead to reduced sea surface temperature, thereby providing a negative feedback on cyanobacteria surface accumulations.
We study the effect of a changing phytoplankton community composition to one dominated by buoyant cyanobacteria on the physical oceanic properties. We use the general circulation model MITgcm and set up an idealized biological model taking into account the phytoplankton species' characteristics as well as the effects of biology on physics. The model results show an increase in the relative abundance of buoyant cyanobacteria leading to changes in mixed layer dynamics and circulation patterns.
Overall, our model results suggest that the development of cyanobacterial surface blooms and their feedbacks on ocean physics need to be taken into account in ocean models used for climate scenarios in order to capture changes in the dynamics of the upper ocean.

How does iron fertilization influence the bacterioplankton community? – A LOHAFEX report

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In the South Atlantic, iron is the limiting nutrient for primary production and thereby the productivity of the whole ecosystem. The large-scale iron fertilization experiment LOHAFEX was conducted in an eddy about 15° W and 47.5° S, in order to create an algae bloom of 300 km² and to investigate the response of the ecosystem to the fertilization for 38 days. Higher productivity effects several levels of the wood web and triggers the biological carbon pump. Here we report the effects of iron fertilization on the bacterioplankton community. Major marine microbial groups, namely *Alphaproteobacteria*, *Gammaproteobacteria*, *Bacteroidetes* and *Crenarchaea*, and the main subgroups where monitored using CARD FISH, automatic cell counting and Tag Sequencing. Even though higher leucine and thymidine uptake rates where measured, total cell numbers where stable during the experiment. Total bacterial numbers, as well as the abundance of *Gammaproteobacteria* did not change significantly in response to the two iron fertilization steps. *Bacteroidetes* decrease in the first days of the experiment. Only SAR11 showed an increase during the time of the experiment, decreasing again towards its end. This increase of SAR11 explains the increase of alphaproteobacterial abundance, while *Roseobacter* did not change significantly. The abundance of *Crenarchaea* increased expectedly only with depth, but not in the surface layer. This remarkably stable bacterioplankton community points towards a strong top-down control by protist grazers. We speculate that SAR11 cells are able to escape grazing due to their small cell size.

Potential predictability of North Atlantic heat transport based on an oceanic state estimate

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We examine the potential predictability time scales of the North Atlantic meridional heat transport (MHT) and its relation to the potential predictability time scales of the meridional overturning circulation (AMOC) on interannual time scales using a hindcast ensemble based on an oceanic data assimilation product. For our investigations, we use the GECCO synthesis (Köhl and Stammer, 2008) which provides the initial conditions as well as the boundary conditions. We analyze the potential predictability of the MHT by calculating the prognostic potential predictability (PPP) following Pohlmann et al. (2004). Within the employed model set-up, the results indicate that the MHT is only potentially predictable in the subtropical and subpolar gyre. The underlying mechanisms which characterize the PPP of the MHT differ in the gyres: The influence of the gyre component of the MHT appear mostly restricted to the subpolar latitudes, whereas the influence of the overturning component of the MHT appear mostly restricted to the subtropical latitudes. Particularly at the gyre boundary, the PPP of the MHT is limited by high Ekman transport variability. In turn, the gyre separation is less pronounced in the PPP of the AMOC. Further, the PPP of the AMOC is only similar the PPP of the MHT where the overturning component controls the PPP of the MHT (subtropical gyre), while they are not similar where the gyre component controls the PPP of the MHT (subpolar gyre). The demonstrated gyre dependence of the PPP time scales of the MHT and AMOC requires caution when interpreting single latitude model-based potential predictability, and calls for further gyre-dependent MHT and AMOC observations.

Modelling the potential distribution of cold-water corals based on terrain parameters

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The cold-water coral species *Paragorgia arborea* and *Primnoa resedaeformis* are two abundant and widely distributed large gorgonians in North Atlantic waters. Both species add significant habitat complexity to the benthic environment, and support a host of invertebrate species. Mapping their distribution is essential in conservation and resource management, but challenged by their remoteness. In this study, three predictive models - Ecological Niche Factor Analysis, Genetic Algorithm for Rule-Set Prediction and Maximum Entropy were applied to model both species' potential distribution at Røst Reef on the Norwegian margin based on multiscale terrain variables.

All three models were successful in predicting potential distribution of both gorgonian species at the Røst reef, and the Maxent predictions outperformed other predictions. The suitable habitat was predicted to mainly occur around the upper slide, on and along the ridges in all the three predictions for each species, which suggests both species tended to live on topographic highs. The ENFA and Maxent provided information about the relative importance of terrain variables, and suggested the importance of aspect and relative position of the seabed for both species distribution. The broad scale (90 m and 170 m) terrain variables with importance may suggest that the large scale terrain features, such as the large ridges, play a role in influencing the distribution of both gorgonian species by steering the local bottom current regime, and thus enhancing nutrient supplying and larvae concentration.

Geoacoustic properties of shallow gas accumulations in Baltic Sea sediments – which can be used for quantification?

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Coastal areas and adjacent seas are hotspots of biogenic methane formation, shallow methane accumulations also occur widespread in the muddy Holocene sediments of the Baltic Sea. Gassy sediments are becoming increasingly important in studies of climate change, because their magnitude of gas storage and potential instability are not known and if released, methane heats the atmosphere with an efficiency 25 times that of carbon dioxide.

When present even in very small amounts, gas bubbles can dominate the geoacoustic characteristics of marine sediments, causing markedly reduced compressional wave speed and bulk density, increased compressional wave attenuation and altering the sediment reflective properties. The resonance of gas bubbles at a fundamental frequency, which is determined by the bubble size, makes the acoustic response and the behaviour of the geoacoustic properties dependent on frequency. The objective of our study was to examine the variation due to the gas content in the geoacoustic properties of marine sediments: velocity, attenuation, and reflectivity; first, to characterize the gassy sediments and their frequency dependent acoustic response, and second, based on the measurements, to provide estimates of the quantity of gas. For the latter, the variation in the seismic attribute 'Amplitude Versus Offset' was investigated as well, which is sensitive to variations in the gas/fluid content of the sediment pore space. For the measurements, we analysed high resolution multichannel seismic data to derive the sound speed, reflection coefficients and AVO variation of gassy sediments and Parasound sediment echosounder data recorded at three frequencies to investigate the wave attenuation.

Estuarine processes and grain size distribution of suspended particulate matter within the São-Francisco Delta, Brazil

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Since the early 1950s, the course of the Brazilian São-Francisco River is intensively exploited for electric-power generation. The seven dams build along the river course, are now controlling 95% of the fluvial discharge, reducing 30% of the water volume and limit sediment transport towards the coast. Indeed, coastal retreat up to 98 m per year is observed at the river mouth over the last few years. The delta of São Francisco now faces estuarine conditions, which might be due to river damming.

A Conductivity-Temperature-Depth probe, a Niskin water sampler, a Laser-In-Situ-Scattering-and-Transmissometry system, and an Acoustic Doppler Current were used on profiles covering the first 40 km of the river-mouth to analyse water temperature, salinity, particulate organic matter (POM), suspended sediment concentrations (SSC), particle sizes and current velocities.

Salinity gradients, which are found up to 9 km upstream, indicate water circulation patterns, which are most typical for salt-wedge estuaries. Suspended particulate matter from fresh and salt water reaches is composed of fine grains (main mode 74.5 – 87.9 µm), containing mean POM contents 23%. Again, at the fresh/salt water interface, measured particles sizes are considerably larger (main mode 280.1 – 460.3 µm), indicating particle flocculation. There seems to be strong evidence that these particle aggregates do not settle down to the river-bed during short slack-water phases of only few minutes, but are transported along the interface. These findings can be linked to results of previous studies, where an off-shore transport of SPM beyond the delta-mouth bar is postulated.

Testing a new temperature proxy in an eastern boundary current system (SE Pacific off Chile).

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Long-chain diols are lipid biomarkers produced by diatoms of the genus *Proboscia*. Former studies used these diols for reconstruction of upwelling conditions, and recently, a chain-length index of these diols has been tested as proxies for SST in the tropical eastern Atlantic Ocean. To date there is only one record of these biomarkers off southern Peru.

The Peru-Chile Current system is one of the most productive eastern boundary ecosystems in the world ocean. In addition, this area shows large-scale variability (El Niño, decadal and centennial), and has an extended dynamic oxygen minimum zone (OMZ). It is also characterised by a steep N-S gradient in environmental conditions such as rainfall, upwelling intensity, and continental freshwater input.

In this study, we aim at testing the diol chain-length index as a SST proxy in a coastal upwelling area with a wide spectrum of environmental conditions. Here, we use observations from the cruise SO156/1, satellite data, and model results to analyse the influence of environmental factors (SST, nutrients, chlorophyll, mixed layer depth, river inputs of freshwater and nutrients) in the abundance of long-chain diols in the surface sediments of the SE Pacific Ocean from a transect between 22°S to 44°S and 70°W to 75°W.

A palynological study to assess the influence of the Atlantic overturning circulation on West African vegetation and climate during the Pliocene

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The variability of the Atlantic meridional overturning circulation (AMOC) is supposed to be a driving force for climate changes in NW Africa during the Quaternary (Mulitza et al. 2008). To test this hypothesis also for the Pliocene, we will specifically investigate the Mid-Pliocene Warm Period (MPWP), 3- 3.3 My (Dowsett et. al., 2007) and the period before. During the MPWP, the closure of the Central American Seaway (CAS) strengthened the AMOC, increasing humidity in tropical North Africa (DeMenocal and Rind, 1993). We will present preliminary results of a palynological study of the well dated marine sediment cores from ODP Site 659 (18°05'N 21°02'W and 3070 m water depth) with a high temporal resolution (~4 Kyr). ODP Site 659 is located outside the upwelling area under the distal Canary Current and is reached by the North Atlantic Deep Water (NADW). The site also lies directly under the main stream of the Saharan Air Layer which carries dust, plant waxes, and pollen out of the African continent. The pollen record will be used to study vegetation changes on the continent, while organic-walled dinoflagellate cyst assemblages will be used to characterize water masses and ocean surface conditions of the eastern tropical North Atlantic. We plan to compare our results with stable hydrogen isotopes of plant waxes and with dust flux data, and aim to establish a direct ocean-land correlation.

Structure of fluid seepage sites and associated BSR distribution on the salt-controlled Angola continental margin

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The passive continental margin that is present in the Lower Congo Basin is controlled by two main processes. The margin is widely dominated by active salt tectonics of Aptian evaporites including the buildup of massive salt at the Angola escarpment, extensive salt diapirism as well as salt raft tectonics in the more landward regions of the Lower Congo Basin. Additionally, the margin is supplied with large amounts of sediment by the Congo River whose deep sea fan is thought to be active since the early Oligocene.
During RV Meteor Cruise M76/3, a multichannel seismic survey in the Lower Congo Basin augmented by sediment and water column echosounder and bathymetric swath mapping data investigated the structural setting of active fluid seepage in this complex context. Fluid and gas seepage processes on top of diapiric ridges seem to be coupled to gas accumulations at very shallow depths as well as at the base of the Gas Hydrate Stability Zone and controlled by the salt tectonic as well as the sedimentary regime of the area. The Bottom Simulating Reflector, indicative of gas and gas hydrate presence in the subseafloor, is restricted to the regions above salt diapirs and shows large lateral amplitude variations in the research area. These effects are caused by differential permeability of turbiditic and hemipelagic sedimentation in the inter-diapiric basins.

A 3D full-Stokes finite-element model for Pine Island Glacier

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Ice Sheets and Glaciers are very important elements of the Earth System. Glaciers are known to respond quickly to changing climatic conditions, while ice sheets have long been seen to vary substantially only on timescales of centuries to millennia. This view is changing as increasing numbers of observations show a much faster response of ice sheets to climatic change. The cause is believed to be a dynamic response of ice streams in the ice sheet. Rising temperatures not only cause more extensive surface melt, but can also modify the flow speed and pattern of the ice. The increased mass transport towards the coast and increased calving rates are a much more effective way of shifting mass from the ice sheet to the ocean than surface melt alone.
The observed mass loss of Antarctica is concentrated on the marine West Antarctic Ice Sheet (WAIS), along the Amundsen Sea Embayment area. Pine Island Glacier is situated in this region. It is a long outlet glacier with a small floating ice shelf. In the past decades it has undergone massive changes such as acceleration and thinning. Additionally, the grounding line, the transition zone between grounded and floating ice, has retreated considerable. Studies suggest that the observed changes are triggered by warm ocean waters reaching the ice shelf, leading to changes in the buttressing and basal conditions at the grounding line.
We aim to simulate the dynamics of this ice stream – ice shelf system. We use a full-Stokes approach, which considers all stress terms mandatory for simulating the stress transition from the grounded to the floating part. This grounding line zone also requires very high resolution modelling. To minimise the computational expenses an adaptive mesh refinement is applied for this area.

Molecular characterization of terrestrial, permafrost-derived organic matter along a soil-river-ocean transect (Lena Delta, NE Siberia).

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About 50% of the global soil organic carbon (OC) is stored in Arctic permafrost soils. In response to global climate warming vast amounts of this mainly freeze-locked, old OC will likely be remobilized and released during permafrost thawing. However, until now the fate of organic matter released from permafrost and its possible feedbacks for the global carbon cycle are hardly understood.
In order to characterize the molecular composition of permafrost soils as well as potential compositional changes during transport from land to ocean, we analyzed biomarkers from soil samples, suspended particulate matter (SPM) and sediments from the Lena Delta and adjacent Buor Khaya Bay, NE Siberia. The soil samples were analyzed for their biomarker composition including leaf wax & soil derived lipids, and lignin phenols to identify those permafrost compounds that should also be detectable in riverine and shelf-derived surface water POC and sediments, respectively. Here, we report the lignin phenol composition of soil samples, POC, and sediments. Furthermore, we report syringyl/vanillyl (S/V) and cinnamyl/vanillyl (C/V) ratios of soil, POC and sediments in order to distinguish between different vegetation types (i.e. angiosperm vs. gymnosperm and woody vs. non-woody plants). This will help distinguishing spatially different terrestrial OC sources since the southern Lena River catchment is mainly characterized by taiga forest whereas the Lena Delta is characterized by tundra vegetation. With these results, we provide new molecular data for determining the current state of permafrost-derived OC transferred from land to ocean in the Lena Delta region.

Seasonality of dust found in the Holocene and glacial period of the NGRIP ice core.

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Greenland ice core studies provide information of past variations of atmospheric aerosol content under different climatic conditions with high (low) concentrations during glacial (interglacial) periods. Higher dust content in Greenland ice cores can be explained by increased desert area in central Asia and a strengthening of the Asian winter monsoon. High resolution dust measurements provide information about past abrupt climate fluctuations.
In this study, five ice sections from the NorthGRIP ice core have been analysed in a sub-annual resolution in terms of dust concentration using a Multisizer Coulter Counter. The ice samples, covering timeslices between 9900 to 35000yr b2k (before 2000, according to GICC05), are taken from the early Holocene, the Allerød IS, the Last Glacial Maximum (LGM), cold glacial, and the Dansgaard-Oeschger (DO) event 7. During warmer periods (Holocene, Allerød IS, DO event 7) we find average mass concentration varying from ~118 µg kg^{-1} to ~328 µg kg^{-1}, during the LGM (late glacial) we find higher dust mass concentrations of ~2480 µg kg^{-1} (~5620 µg kg^{-1}).
In all time slices, we observe seasonal variations with one dust peak within a year and amplitudes of a factor of 7-10; secondary maxima are visible in the Holocene and Allerød IS. These seasonal variations were used to carry out accurate dating applying annual layer counting. We found annual layer thicknesses of ~6.41 cm in the Holocene, ~4.83 cm in the Allerød IS, ~1.85 cm in the LGM, ~1.39 cm in the cold glacial and ~2.68 cm during the DO event 7.

Sub-seasonal climate reconstruction from southern Caribbean corals during the Classic Maya collapse

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Researchers have hypothesized on the many causes of the demise of the Classic Maya civilization during the Terminal Classic Period (TCP; 850/900 to 1000 C.E.) in the lowlands of the Yucatán Peninsula. Explanations ranged from foreign invasion to social turmoil but recent evidence suggests severe climate change such as prolonged dry cycles as the primary influence. High-resolution records from ocean/lake sediments, stalagmites, and dendrochronology studies have all indicated significant influence of abrupt climate and precipitation changes of sustained droughts within the late Holocene coinciding with the time period of Classic Maya civilization collapse. Recently collected fossil coral colonies from Bonaire in the Caribbean region that grew during the TCP were analyzed for Sr/Ca and $\delta^{18}O$ at bimonthly to seasonal resolution as proxies of sea surface temperature (SST), sea surface salinity (SSS), and hydrological changes. These proxy records show distinct seasonal variability and trends in both SST and SSS indicating possible deviations in the hydrological cycle in which increased evaporation or decreased precipitation yielded more saline surface ocean conditions during the TCP. Evaluation of a modern coral colony also provided modern baseline conditions as basis of comparison to track the changing temperature and precipitation during the TCP in the southern Caribbean. The results from this study include insight into Caribbean climate during the TCP, Atlantic Intertropical Convergence Zone variability, and possible Atlantic-Pacific ocean-atmosphere interactions. These results will also significantly add to the discussion on cultural responses (collapse of the Classic Maya civilization) and global climate change.

Uncovering the key processes involved in manganese biogeochemical cycling in the Ocean.

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Mn forms a critical part of many redox enyzmes most notably for photosynthesis, where as part of Photosystem II it converts H2O to O2. Many marine organisms also contain Mn superoxide dismutases (SOD), that act as part of the intracellular defences against reactive oxygen species (ROS) and in particular rapidly convert superoxide (O2-) into O2 and H2O2. Laboratory studies have shown that the growth of marine phytoplankton is reduced for some species at the low Mn concentrations found in open ocean seawater which is supplied with Mn predominantly via the deposition of aeolian dust and subsequent dissolution of Mn(II) from the particles. The released Mn(II) is slowly oxidized (via biota or chemically) to insoluble MnO2 which precipitates out of the water column. In the sunlit ocean, H2O2 can reduce MnO2 back to Mn(II) completing a redox cycle. New work suggests that transient Mn(III)-species may play an important role in both the Mn and Fe biogeochemical cycles in surface waters.
In this presentation we will present data for Mn concentrations, speciation and kinetic reactivity from two research cruises in the Tropical Atlantic (M83-1 and MSM17-04) and from a dust deposition experiment performed in trace metal clean mesocosms in the Mediterranean (DUNE2). We will use our combined dataset to determine the predominant source of Mn to shelf waters in the Mauritanian upwelling region and the adjacent open ocean in the Tropical Atlantic, which are impacted by both Saharan dust and potentially coastal sedimentary sources that are advected offshore by the upwelling waters.

Shallow gas transport and reservoirs in the vicinity of deeply rooted mud volcanoes in the central Black Sea

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Gas discharge in the central Black Sea is commonly associated with mud volcanism. As gas emissions at mud volcanoes are dominated by methane, mud volcanoes (MV) represent an important natural source of methane contribution to the atmospheric carbon budget with great potential impact on the global climatic change. The study of shallow gas transport and reservoirs in the vicinity of mud volcanoes can provide useful information to better understand gas discharge.
High resolution multichannel seismic lines were collected by the University of Bremen during R/V Meteor Cruise M52/1 in January 2002 in the central Black Sea.11 seismic lines GeoB 02-026 – GeoB 02-036 have been shot to image the principal structures of the central Black Sea in the vicinity of known mud volcanic surface features. A GI-gun (generator-injector gun, 2 x 1.7 L) was used as seismic source, generating frequencies in the range of 50 to 250 Hz. The 11 seismic lines crossed 6 mud volcanoes: MSU, Yuzhmorgeologiya, Malyshev, Kornev, Goncharov and Vassoevitch. Based on a high resolution seismic processing, we analyzed acoustic anomalies and studied near-surface sediment structures of deeply rooted mud volcanoes. An evolutionary model for the deeply rooted mud volcanoes will be presented with respect to mechanisms of gas migration. In particular we focus on the fine scale anomalies of seismic amplitude and coherency in the MV vicinity as well as on the vertical succession of structural features.

Modeling the life cycle of a dormant species in the North Sea

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A life cycle model for a dominant zooplankton species (Acartia clausii) is developed and calibrated using the data from the North Sea. Aiming to study the effects of the dormancy period on zooplankton biomass and the development during the life cycle, the model discriminates different life cycle stages, including two types of eggs: subitaneous eggs and dormant eggs. The production of either subitaneous eggs or dormant eggs is a function of environmental conditions. It is assumed that the dormant eggs have to undergo an obligatory dormancy period before they can hatch. Several numerical experiments are conducted to test the sensitivity of the zooplankton life cycle towards the dormant behavior and the physical environment. The results show that the timing and amplitude of the spring blooming are strongly influenced by the magnitude and maturation status of the dormant eggs as well as the environmental conditions during hatching. In the model experiment in which zooplankton produces only subitaneous eggs, the blooming is later and the amplitude is also reduced. In addition, the model experiments indicate that during the summer subsurface production of zooplankton, the dormant egg production is strongly affected by the physical environmental conditions. In years with unfavorable environmental conditions, the adults tend to produce more dormant eggs in order to increase the recruitment success in the following year. Overall, the study shows that the life cycle including dormant eggs need to be considered in models aiming to represent the seasonal cycle of Acaria in shallow coastal seas.

Trouble in mega-cities under a changing climate: Water scarcity and floods in Pearl River Delta, China

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Normally, the urban cluster of the Pearl River Delta (PRD) in southern China is portrayed as an area of water abundance. However, this is not the full picture of the water problems in these mega-cities. Due to various reasons, water problems of PRD mega-cities fall into two extremes. At one extreme is the monsoon period between April to September when the area becomes flooded due to heavy rainfall within the whole river basin and some typhoon or tidal events. At the other extreme is the dry season between October to March when the cities become water stressed due to low and unsustainable water availability. Water scarcity in these mega-cities is characterized by seasonal insufficient precipitation, seawater intrusion, increasing water pollution, poor water facilities as well as decreasing water amount per capita due to increasing population. While the PRD area is already threatened by these kinds of natural and man-made developments, additional risks posed by climate change to these cities and their people will likely enlarge the disaster scale.

Thus mitigating floods and ensuring enough water availability are the two major water resources management challenges for PRD mega-cities. This paper discusses several priorities to address the water issue, including water resource planning, water right institutions, market-based approaches, and capacity building. Finally, this paper stresses that the cities' authorities should revisit the region's development plan to develop a long-term, integrated water management strategy that recognizes the added risks from climate change and rapid development.

Climate variability in China in the last 1200 years in simulations and reconstructions

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Overview of two-and-half-years PhD work: The climate in China is simulated using the atmosphere-ocean general circulation model ECHAM5/MPI-OM for 800-2005AD subject to anthropogenic and natural forcings. The two ensemble simulated temperature (five/three members) are compared with three reconstructions in terms of anomaly time series and power-spectral analysis. One simulation and one reconstruction are selected for further analysis including centennial spatial patterns and regional anomaly ensemble spread. Note that simulations shows long term memory including an ENSO (El Nino/Southern Oscillation) signature and volcanoes turn out to be the dominant forcing in both ensembles. Therefore, the co-operative effects of volcanic eruptions and ENSO on the climate in China (Temperature and Standardized Precipitation Index, SPI, JJA)) are analyzed as following: First, the volcanic effects in the absence of ENSO events during the year after the eruption as well as the assessment of the recovery times for the volcano induced cooling (globally and in China). Secondly, the ENSO effects without volcanoes; and Thirdly, the combined volcanic and ENSO effects. As a case study, the simulated impact of the eruption of the Tambora in 1815, which caused the 'year without summer' 1816 in Europe and coldness and famines for several years in the Chinese province Yunnan, depends crucially on the ENSO state of the coupled model. A comparison with reconstructed El Niño events shows a moderate cool climate with wet (in the South) and extreme dry anomalies (in the North) persisting for several years.

Detection of Microbial Biomass in Subseafloor Sediments by Pyrolysis-GC/MS

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Pyrolysis-GC/MS is an excellent approach to rapidly generate low-molecular fingerprints from organic macromolecules. It has been successfully applied to characterize microorganisms and differentiate between them. Considering this, we want to explore a method using Py-GC/MS to rapidly screen for the presence of labile macromolecules associated with living microbes in the deep biosphere.

To adapt this method to the analysis of sedimentary matrices, we first pyrolyzed cells of different archaeal and bacterial lineages as well as reference substances and model compounds to obtain fingerprints for living microbial biomass. Pyrolysis products derived from proteins, carbohydrates and nucleic acids generally dominated the pyrolysates. Although the relative distributions of these compounds varied between the strains, no specific archaeal or bacterial fingerprint could be identified so far. By pyrolyzing surface sediments from the Peru Margin we tested to what extent the fingerprint of microbial biomass could be recovered from the benthic ecosystem. As expected some nitrogen-bearing fragments derived from proteins, amino sugars and nucleic acids occur both in microbial cultures and surface sediments. Momentarily we are testing to what extent we can follow our target compounds down into the deep biosphere. Preliminary analyses show that at around 100 m below the sea floor signals can be still detected. We will further explore the occurrence of living microbial biomass in deeply buried sediments.

Trace Analysis of Methylated Substrates in Marine Sediment

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Methane in marine sediment has received great attention because of its role as greenhouse gas and as major constituent in gas hydrate and its significance in driving the benthic carbon cycle in many seep environments. Among all the biological pathways leading to methane production in marine sediment, methyltrophic methanogenesis via non-competitive substrates, such as methanol, methylated sulphides and methylamines, is the least understood one [1]. Activity studies demonstrated that degradation of volatile methylated compounds could account for the substantial fraction of methanogenesis in some anoxic sulfate-rich sediments [2]. Yet, the significance of this process under in situ conditions remains unclear due to the lack of concentration data of these compounds in subseafloor sediment.

We are currently establishing analytical protocols suitable for the quantitative and isotopic analysis of methylated substrates. We are adapting and improving two existing pre-concentration methods, i.e., solid-phase micro-extraction and purge-and-trap techniques, for quantification of these compounds in diverse sediment samples. Once the analytical barrier is overcome, we envision extensive application of the method, such as down-core survey of marine sediment and further adaptation of the method for isotope ratio analysis. Our paper will discuss the success and challenges of the molecular-isotopic analysis of these trace constituents.

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CliSAP/KlimaCampus: Excellent Climate Research in Hamburg

CliSAP/KlimaCampus, Hamburg

The cluster of excellence CliSAP has concentrated and cross-linked climate research in Hamburg since 2007. The partner institutions are the University of Hamburg (18 institutes), the Max Planck Institute for Meteorology, the Helmholtz-Zentrum Geesthacht and the German Climate Computing Centre. Natural and social sciences are strongly linked. The partners involved in the cluster have grown together to become the KlimaCampus in the past few years. Infrastructure elements such as the data center, the model development, large equipment like the boundary layer wind tunnel and the information technology are utilized jointly.

Our key questions:

Climate Analysis

- How have atmosphere, ocean and continents changed in the course of time?
- Which changes occur in global water, energy and carbon fluxes?

Climate Variability

- Which components of the climate can be predicted over which periods?
- How can we improve the predictions?

Regional Effects and Risks

- What are the climate risks for marine, terrestrial and urban systems – especially in Northern Europe?

Climate and Humans

- What are the economic and social interactions?
- Can we keep global change within a certain limit?

The Future Ocean – 2012 and beyond

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The ocean, through its dominating influence on global climate and its growing role as a source of natural resources but also of devastating hazards, plays a key role in the lives of all human beings. At the same time, the ocean is increasingly affected by human activity including anthropogenic CO_2 emission, non-sustainable fisheries, large scale waste disposal, and other pollution. 'The Future Ocean', intends to continue and strengthen its interdisciplinary investigation of past, present and future ocean changes, to explore strategies for the sustainable and environmentally friendly use of marine resources, and to promote the integrated study of marine hazards.
Expertise from all marine disciplines will be combined with socio-economic, legal, political and ethical aspects of the ocean in a truly multidisciplinary approach. The new research program will aim at an even higher level of integration to foster the fundamental understanding of the oceans, which will feed into the development of science-based predictions and scenarios, which in turn provides crucial information to decision makers on the use of ocean resources, associated ocean governance, and environmentally sound management practices.
The research will be continued beyond the second phase in the newly founded 'Kiel Academy of Interdisciplinary Marine Sciences' (KAIMS) with its science support units: targeted research platforms, an integrated graduate school (ISOS), a postdoc program (IMAP), knowledge transfer, outreach and internationalization activities. Overall, the Cluster will further strengthen and promote the University's profile in integrated Marine Sciences in close collaboration with its partners.

The Bremen International Graduate School for Marine Sciences - GLOMAR

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The Bremen International Graduate School for Marine Sciences GLOMAR (Understanding Global Change in the Marine Realm is funded by the Deutsche Forschungsgemeinschaft (DFG) within the frame of the Excellence Initiative by the German federal and state governments to promote science and research at German universities. GLOMAR provides a dedicated research training programme for PhD students in all fields related to global change in the marine realm combined with an exceptional supervision and support programme in a stimulating research environment. The four research areas, (A) Ocean and Climate, (B) Coastal Zone Processes, (C) Marine Ecology and Biogeochemistry and (D) Challenges to Society, combine all disciplines of marine research. Besides the classical natural sciences, GLOMAR comprises also law and social sciences related to marine and coastal research.
GLOMAR students work in an interdisciplinary and international context. They spend several months at a foreign research institution and are encouraged to actively participate in international conferences and publish their research results in international scientific journals. The services GLOMAR offers for its PhD students include team supervision by a thesis committee, a comprehensive course programme, research seminars and retreats, a family support programme, a mentoring programme for women in science, an ombudsperson and a funding system for conference trips, research residencies, publication costs and student assistants. In addition, GLOMAR offers internships for international PhD students and funding for several PhD fellowships every year.
More information can be found on the GLOMAR homepage: www.glomar.uni-bremen.de

Education for „The Future Ocean“: Kiel Marine Sciences

Dr. Avan N. Antia, Kerstin Hoffmann, Angelika Hoffmann

Marine sciences is a dynamic thematic focus of the University of Kiel, Germany, uniting natural scientists, economists, lawyers, computing and medical scientists in frontier research into the scientific, economic and legal aspects of the seas.
Marine science education in Kiel is largely research-driven, and focuses on training the next generation of scientists to investigate the role of the oceans in global change, resources and risks arising from the use of the oceans and sustainable management of living and non-living resources. Basic fundamental research is supplemented with applied science in a national and international framework that includes partners from industry and public life.
The PhD Programme of the Integrated School of Ocean Sciences (ISOS) focuses on interdisciplinary education outside of curricular courses. It offers supplementary training, a framework of supervision, mentoring and mobility for doctoral candidates. At the ISOS, students sharpen their scientific profile, are challenged to think beyond their discipline and to equip themselves for life after a PhD. Over 130 PhD candidates from 5 faculties participate in the PhD programme, forming a large interdisciplinary network across disciplines. This network extends also beyond Kiel with contacts to Young Earth System Scientists (YESS) and a joint workshop on Marine Conservation with GLOMAR.
The focus at the ISOS is on providing tangible benefit to the individual PhD, through early exposure to topics beyond research such as social responsibility, public communication, global sustainability etc. Input to the programme by senior cluster members, alumni and persons from industry and public life encourage PhD candidates to form early networks and set their goals for life after the doctorate.

The Ocean in the Earth System

MARUM – Center for Marine Environmental Sciences at Bremen University

At MARUM, the Center for Marine Environmental Sciences at Bremen University, scientists and technicians investigate the critical role of the ocean in the Earth System.
Under the auspices of MARUM, a DFG Research Center with the same name was established in 2001, and an Excellence Cluster was founded in 2007. As of 2011, MARUM, as a university research institute, is responsible for strategic development of the major research area dealing with marine, climate, and polar research at Bremen University.
MARUM is active in three general research fields: ocean and climate, biogeochemical processes on and in the sea floor, and sediment deposition and transport. These main research areas provide information for sustainable use of the oceans. MARUM actively participates in international research programs and operates the largest of the three world-wide core repositories of the Integrated Ocean Drilling Program (IODP).
MARUM operates in all of the world's oceans, and from the coasts down to the deep sea. Geographically, the major research areas include the North and Mediterranean Seas, and the equatorial and southern Atlantic Ocean, and the Black Sea.
Because of its great expanse, the study of the sea floor is literally a broad field. Research vessels therefore deploy remote-controlled submersible vehicles, the Bremen sea-floor drilling rig, autonomous submersible vehicles, and other special technological instruments. MARUM operates a fleet of the most modern underwater instruments for deployment in the deep sea, and has become a recognized worldwide center for marine research technology.

Interdisciplinary MSc and Doctoral Education in Climate System Science at the University of Hamburg

Armine Avagyan*, Eva-Maria Pfeiffer, Detlef Stammer, Oliver Dilly

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Modern research and education in climate system sciences is based on the combination of disciplines such as meteorology, geophysics, oceanography, geosciences and also economics and social sciences. Knowledge across these disciplines is required to address key climate issues in an integrated way. Therefore ,the School of Integrated Climate System Sciences (SICSS), a part of the Hamburg Cluster of Excellence „Integrated Climate System Analysis and Prediction“ (CliSAP) of the University of Hamburg which collaborates with the Max Planck Institute for Meteorology, Helmholtz-Zentrum Geesthacht and the German Climate Computing Centre, aims at linking these diciplines and offers a research-driven and interdisciplinary 2-yr MSc program in Integrated Climate System Sciences with 120 ECTS credit points and 3-yr structured doctoral program. Each doctoral student is guided by an advisory panel (AP), which meets at least bi-annually. The AP consists of a Principal Advisor, a Co-Advisor and a Chair of the panel who come from neighboring disciplines. The structured doctoral program from which each doctoral student need to gather a minimum of 12 credit points includes interdisciplinary compulsory courses and also tailor-made eligible expert courses. In addition, SICSS funds summer schools, conferences and language courses. Twelve MSc students and 75 doctoral students are already enrolled since SICSS was opened in 2009. More international students than national students are enrolled in the MSc program, while in the doctoral program, the number of international students ranges presently at 33 % but is continuously increasing. More information can be found on the SICSS website: http://www.klimacampus.de/sicss.html.

Young Earth System Scientists.

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Earth system science in Germany is split up into many high profile institutes and universities across the country. Especially for early-career scientists, the communication infrastructure is maintained mainly by graduate schools. Therefore, inter-institute communication is often lacking.
YESS is a PhD student maintained superstructure that tries to integrate communication among young researchers (from students to post-docs) working in the field of Earth system sciences across Germany. Instead of replacing any activities or organizations, YESS wants to connect and incorporate ongoing efforts. The main goals of YESS are the improvement of communication amongst young scientists in the field, furthering the establishment of personal networks, and development of synergistic effects within the Earth system sciences.
The first goals of YESS are to establish an internet communication system, an annual PhD student conference and regular workshops, thereby enabling the YESS members to search, learn, and share their research as well as providing opportunities for personal interactions.
For now, YESS is focused on young researchers working at German research centers. Yet, YESS wants to establish connections to similar international efforts since our long-term goal is to strengthen international collaboration.

"YOUMARES 2.0 - 2nd Young Marine Research network meeting and conference 2011: Oceans amidst science, innovation and society"

Stefan Meyer

Organization Committee of YOUMARES, Member of the working group Studies and Education of the German Society of Marine Research, Bundesstraße 53, 20146 Hamburg, Germany, info@youmares.net.

YOUMARES is the name for the annual networking meeting and conference of young marine researchers, organized by the working group Studies and Education of the German Society of Marine Research. In this year, 2011, YOUMARES was held under the topic: "Oceans amidst science, innovation and society" at the German Maritime Museum in Bremerhaven, Germany, from September 7th-9th. Once more, YOUMARES provided a platform for networking, gathering information and future perspectives for young marine researchers. Presentations and poster sessions gave an overview about new research topics from the full-spread domain of marine research. Six thematic sessions covered the topics: 1) Human impacts on the oceans and subsequent environmental responses, 2) Remote sensing: Higher orbits for deeper understanding, 3) Living with the sea: coastal livelihoods and management, 4) Aquaculture: Main research priorities to fulfill our need for sustainable seafood, 5) Marine Technology – The art of engineering in synergy with natural sciences and 6) Ocean of diversity: From micro scales to macro results. Besides the conference program, a variety of information was on offer, like desks about different marine institutes, funding, career possibilities and many more. By providing a creative environment for all early stage scientists, YOUMARES hopes to facilitate the entrance into a professional network for those people/students that are willing to take the first step to get involved in this 'grass-root' initiative. The presentation will provide an executive summary of the YOUMARES 2011 activities and will give a perspective for YOUMARES 2012.

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