



INSTITUT FÜR CHEMIE UND BIOLOGIE DES MEERES



STRUCTURE OF THE INSTITUTE

INSTITUTE FOR CHEMISTRY AND BIOLOGY OF THE MARINE ENVIRONMENT

Location Oldenburg (OL) and Wilhelmshaven (WHV)

Director: Prof. Dr. Jürgen Rullkötter; Executive Manager: Dr. Bert Albers

Geochemistry & Analytic

- Organic Geochemistry (OL)
Prof. Dr. Jürgen Rullkötter
- Microbiogeochemistry (OL)
Prof. Dr. Hans-Jürgen Brumsack
- Environmental Biochemistry (WHV)
Prof. Dr. Peter Schupp
- Marine Chemistry (WHV)
Prof. Dr. Gerd Liebezeit
- Marine Geochemistry (OL)
Max-Planck-Research-Group
Dr. Thorsten Dittmar
- Marine Isotope Geochemistry (OL)
Max-Planck-Research-Group
Dr. Katharina Pahnke

Geobiology & Ecology

- Biology of Geol. Processes (OL)
Prof. Dr. Meinhard Simon
- Planktology (WHV)
Prof. Dr. Helmut Hillebrand
- Paleomicrobiology (OL)
Prof. Dr. Heribert Cypionka
- General & Mol. Microbiology (OL)
Prof. Dr. Ralf Rabus
- Geoecology (WHV)
PD Dr. Holger Freund
- Marine Biosensors (WHV)
N.N.

Physics & Modelling

- Theor. Physics/compl. Systems (OL)
Prof. Dr. Ulrike Feudel
- Mathematical Modelling (OL)
Prof. Dr. Bernd Blasius
- Physical Oceanography (OL)
Prof. Dr. Jörg-Olaf Wolff
- Coastal Oceanography (OL)
Endowed Professorship HZG
Prof. Dr. Emil Stanev
- Integrative Modelling (WHV)
Junior Research Group of the ICBM
Dr. Dietmar Kraft
- Marine Sensorsystems (WHV)
Prof. Oliver Zielinski

MISSION STATEMENT

The ICBM investigates the significance of shelf sea and coastal regions as part of the system Earth through an interdisciplinary research approach, bringing together the fields of geochemistry, microbial ecology, marine physics, and modelling. Study programs offered by the ICBM educate the experts of tomorrow in marine and environmental sciences.



THE ICBM FULFILS ITS MISSION IN RESEARCH AND EDUCATION

- through its interdisciplinary organisation,
- as an integral part of the Carl von Ossietzky University of Oldenburg, Faculty of Mathematics and Science,
- as a member of the German Marine Research Consortium (KDM), and the Nordwestverbund Meeresforschung
- through extensive national and international cooperation in research and education,
- through implementation and development of BSc, MSc, and PhD study courses designed for the specific needs of marine and environmental sciences.



RESEARCH PROFILE OF THE ICBM

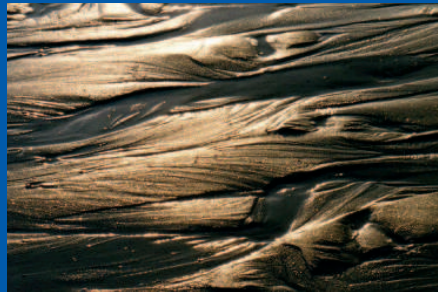
At the University of Oldenburg, the ICBM is a center of excellence in research of shallow seas and the coastal zone. It is the only university-based institute of marine sciences in Lower Saxony. Among the marine science institutions in Germany, the ICBM is well recognized and established with its unique profile. It is a member of the German Marine Research Consortium (KDM), the umbrella organization of the German marine science institutions and in the Nordwestverbund Meeresforschung.

Research activities were concentrated from 2001 - 2009 in the DFG-funded Research Group on **BioGeoChemistry of Tidal Flats**.

Currently, the shallow sea research is focused on the **Research Association Jade Bay** (Forschungsverbund Jadebusen).

In 2010, a new Transregional Collaborative Research Centre was developed: **Ecology, Physiology, and Molecular Biology** of the **Roseobacter Group**.

The ICBM participates in national and international joint programs, e.g. COSYNA (see www.cosyna.de), the Integrated Ocean Drilling Program (IODP), polar- and climate research projects.



STUDY PROGRAMS

Focusing on the marine component, the ICBM offers a range of study programs in environmental sciences. Programs are offered on the Bachelor, Master and PhD level.

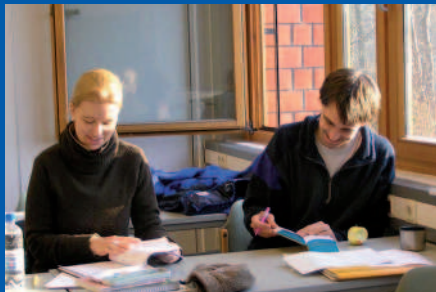
Issues of environment and sustainability have been of high priority in research and education at the University of Oldenburg since its foundation. This makes the university interesting for young people looking for study programs in environmental sciences and promotes its national and international attraction.

The Bachelor Program **Environmental Sciences** offers several specialized courses (e.g.: marine sciences, environmental modeling). Marine systems are the focus of the Master Program **Marine**

Environmental Sciences and the two international Master Programs **Microbiology** and **Water and Coastal Management** (in cooperation with the University of Groningen).

The main training objective of the study course **Environmental Modelling** is to impart sound knowledge on the development of models, data analysis methods, and decision support systems.

Professional expertise and interdisciplinarity qualify the graduates of these programs for a scientific career and various occupational fields with a high future potential, like consulting companies, governmental agencies, ministries and authorities, management of companies, and environmental education.





FACTS AND FIGURES OF THE ICBM



Professorships		13
PhD Scientists	approx.	25
PhD Students	approx.	60
Technical staff	approx.	40
Diploma and Master Students	approx.	75
Grant Money (per year)	approx.	3 mill. Euro

Joint Programs: DFG -Collaborative Research Center:
Transregio 51 „Roseobacter“ (since 2010)

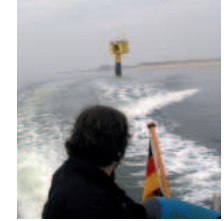
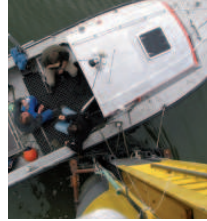
„Baseline Study Jadebusen“
(Lower Saxony, since 2008)

DFG-Research Group
„BioGeoChemistry of Tidal Flats“
(2001-2009)

Infrastructure: Research Vessels „Otzum“ and
„Navicula“

Time Series Station in the Wadden Sea

ORGANIC GEOCHEMISTRY



Head: Prof. Dr. Jürgen Rullkötter
Diploma: TU Braunschweig (1971, Chem.)
Dissertation: Univ. Köln (1974, Chemistry)
Habilitation: Univ. Köln (1986, Org. Geochem.)
Senior Scientist: Research Center Jülich (1975-91, Petroleum and Org. Geochemistry)
ICBM joined: 1992

Key publications:

Freese E et al. (2008): Origin and composition of organic matter in tidal flat sediments from the German Wadden Sea. *Org Geochem* 39:820-829.

Rommerskirchen F et al. (2006): Glacial/interglacial changes in southern Africa: Compound-specific $\delta^{13}\text{C}$ land plant biomarker and pollen records from south-east Atlantic continental margin sediments. *Geochem Geophys Geosyst* (G^3) 7:Q08010, doi:10.1029/2005GC001223

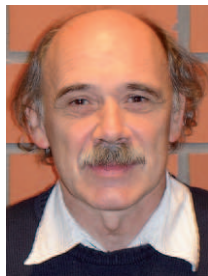
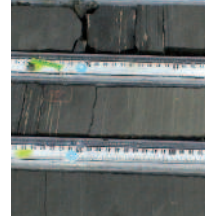
Main Research:

Organic geochemistry traces the fate of organic matter in the different compartments of the geosphere. It deals with the transformation of the remnants of decayed organisms by microorganisms and geochemical reactions down to the formation of crude oil and natural gas in deeply buried sedimentary rocks. Organic geochemistry is a multidisciplinary science combining aspects of analytical organic chemistry, natural product chemistry, and biology with those of sedimentology, oceanography, and petroleum geology.

Research in the **Organic Geochemistry Group** of ICBM is focused on the following areas:

- Biogeochemistry of intertidal sediments
- Depositional history of the Holocene in Northwest Germany
- Continental margins of the world oceans: Paleoclimate indicators and reconstruction of paleoenvironmental conditions
- Petroleum and environment

MICROBIOGEOCHEMISTRY



Head: Prof. Dr. Hans-Jürgen Brumsack
Diploma: Univ. Göttingen (1975, Mineralogy)
Dissertation: Univ. Göttingen (1979, Geochemistry)
Postdoctorate: Scripps Institution of Oceanography (USA, 1980/81)
Habilitation: Univ. Göttingen (1989, Geochemistry)
ICBM joined: 1992

Key publications:

Dellwig O et al. (2007): Non-conservative behaviour of molybdenum in coastal waters: Coupling geochemical, biological, and sedimentological processes. *Geochim Cosmochim Acta* 71:2745-2761.

Brumsack HJ (2006): The trace metal content of recent organic carbon-rich sediments: Implications for Cretaceous black shale formation. *Palaeogeogr Palaeoclimatol Palaeoecol* 232:344-361.

Main Research:

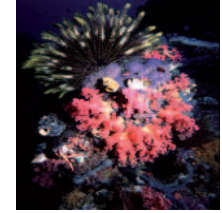
The **Microbiogeochemistry Research Group** (MBG) is specialized in the inorganic geochemical analysis of recent and ancient sediments, in waters, soils, and substances of environmental concern.

Research topics include:

- Biogeochemistry of tidal flat systems along the German North Sea coast
- Cretaceous black shales recovered on Demerara Rise (ODP Leg 207)
- Recent organic carbon-rich sediments (Black Sea, Namibia)
- Arctic Coring Expedition on Lomonosov Ridge (IODP Leg 302)

MBG is operating the Central Inorganic Geochemistry Analytical Facilities. The major analytical instruments are: Wavelength-dispersive XRF (Philips PW 2400), High-resolution ICP-MS (Finnigan MAT Element 2), ICP-AES Optima 3000 XL (Perkin Elmer). Furthermore, MBG is equipped with two AAS instruments, several instruments for bulk parameter analysis (C, S, N), ion chromatography, and devices necessary for sample preparation, sample dissolution, and glass bead preparation for XRF analysis.

ENVIRONMENTAL BIOCHEMISTRY



Head:
Master of Science:
Diploma:
Dissertation:
Postdoctorate:

Associate Prof.:
ICBM joined:

Prof. Dr. Peter J. Schupp
Univ. of Guam (1992, Marine Biology)
Univ. Konstanz (1993, Biology)
Univ. Würzburg (2000, Pharmaz. Biology)
Center for Marine Biofouling and Bio-
Innovation, Sydney, Australia
Univ. of Guam (2003-2010, Chem. Ecology)
2010

Key publications:

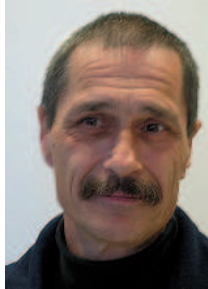
Sharp KH et al (2010): Bacterial Acquisition in Juveniles of Several Broadcast Spawning Coral Species. PLOS ONE 5(5): e10898.doi:10.1371.
Kitamura M et al. (2009): Luminaolide, a Novel Metamorphosis-inducing Macrodiolide for Scleractinian Coral Larvae from Crustose Coralline Algae. Tetrahedron Lett 50:6606-6609.

Main Research:

Chemical Ecology of Marine Invertebrates: Our research aims to understand the ecological function of secondary metabolites from marine invertebrates. We are assessing possible allelopathic, signaling and defense functions of marine natural products in marine invertebrates. One project examines methods for the control of chronic and mass-outbreaks of the Crown of Thorn Starfish *Acanthaster planci*, including the use of natural products. The overarching goal is to combine chemical ecology research with management-oriented studies to develop new strategies for the management and protection of coral reefs. In addition, we evaluate extracts and isolated compounds for their pharmacological potential.

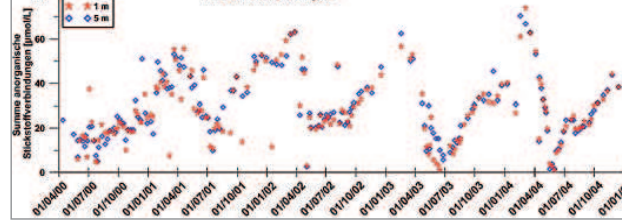
Microbial Ecology: We use sponges as model organisms to study microorganism-invertebrate symbiosis and how secondary metabolites are regulating and maintaining these associations. Besides using traditional and new culturing methods for the construction of an extensive bacterial strain library, we also employ molecular techniques, such as Denaturing Gradient Gel Electrophoresis (DGGE) and pyrosequencing, to describe the microbial diversity. Furthermore, purified compounds from the isolated microorganisms and their invertebrate hosts are evaluated for their ecological and potential pharmacological properties.

MARINE CHEMISTRY



Head:
Diploma:
Dissertation:
Habilitation:
ICBM joined:

Prof. Dr. Gerd Liebezeit
Univ. Kiel (1977, Chemistry)
Univ. Kiel (1981, Marine Chemistry)
Univ. Hamburg (1991, Geology)
2008



Key publications:

Liebezeit G, Wöstmann R (2009): *n*-Alkanes as indicators of natural and antropogenic organic matter sources in the Siak River and its estuary, E Sumatra, Indonesia. Bull Environ Contam Toxicol 83:403-409.

Hertweck G et al. (2006): Bioturbation structures of polychaetes in modern shallow marine environments and their analogues to *Chondrites* group traces. Paleogeogr Paleoclimatol 245:382-389.

Main Research

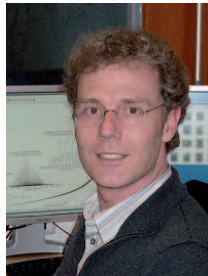
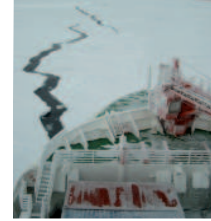
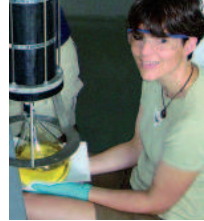
The **Marine Chemistry** group works mainly on inputs and fate of compounds in the marine environment that originate from anthropogenic activities. These are investigated in coastal areas and adjacent freshwater systems. At present we are active in the Jade Bay and the Kachelotplate, Lower Saxonian Wadden Sea, various rivers and their coastal areas in East Sumatra.

We concentrate on

- litter and microplastics as source and sink for organic contaminants
- inorganic nutrients in selected tidal areas - land-based and atmospheric inputs
- mercury in limnic and marine waters and sediments
- chlorinated organic contaminants in sediments and biota
- dating of biogenic carbonates via amino acid racemization
- genesis of dune islands

MARINE GEOCHEMISTRY

Max Planck Research Group



Head:
Diploma:
Ph.D.:
Postdoctorate:
Visiting Scientist:
Professor:
ICBM joined:

Dr. Thorsten Dittmar
Univ. Bayreuth (1995, Geocology)
Univ. Bremen (1999, Marine Chemistry)
Alfred Wegener Institute (2000-2003)
Univ. of Washington, USA (2001-2003)
Florida State University (2003-2008)
2008

Key publications:
Dittmar T, Paeng J. (2009): A heat-induced molecular signature in marine dissolved organic matter. *Nature Geoscience* 2, 175-179.
Dittmar T et al. (2006): Mangroves, a major source of dissolved organic carbon to the oceans. *Global Biogeochemical Cycles* 20, GB1012.

Main Research:

The Research Group for **Marine Geochemistry** is part of the Max Planck Institute for Marine Microbiology in Bremen and located at the ICBM in Oldenburg. Focus of our research is dissolved organic matter in the ocean. Bacteria are nourished by food taken up in solution, dissolved organic matter is therefore essential for all marine life.

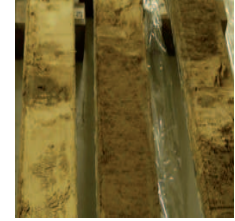
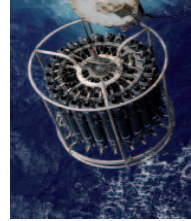
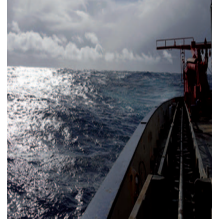
For unknown reasons, dissolved organic matter has accumulated to one of the largest carbon pools on earth. It contains a similar amount of carbon as atmospheric CO₂ and more than all forests

on the continents combined. Advanced molecular techniques help us to unravel the mysteries behind dissolved organic matter.

We have gained novel insights into the molecular world of seawater mainly via ultrahigh-resolution mass spectrometry. With this technique we can determine the mass of a single molecule with a precision of more than 0.0001 Dalton, this less than the mass of an electron. This precision is required for the identification of individual molecules in seawater. Our group hosts the worldwide highest resolving mass spectrometer, the only of its kind in the marine sciences.

MARINE ISOTOPE GEOCHEMISTRY

Max Planck Research Group



Head:

Diploma:

Dissertation:

Postdoctorates:

Associate Scien.:

Research Prof.:

ICBM joined:

Dr. Katharina Pahnke

Univ. Kiel (1997, Geology, Paleontology)

Cardiff Univ., UK (2005, Paeoceanography)

Mass. Inst. of Technology, USA (2004-2005)

Lamont-Doherty Earth Obs., USA (2006-2008)

Lamont-Doherty Earth Obs., USA (2008)

Univ. of Hawaii (2008-2011)

2011

Key publications:

Pahnke K. et al. (2008): Abrupt changes in Antarctic Intermediate Water circulation over the past 25.000 years. *Nature Geoscience* 1, 870-874.

Pahnke, K et al. (2007): Eastern tropical Pacific hydrologic changes during the past 27.000 years from D/H ratios in alkenones. *Paleoceanography* 22, PA4214.

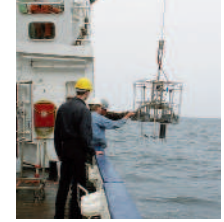
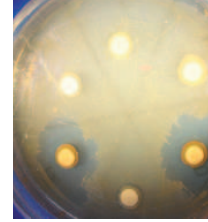
Main Research:

The ocean plays a crucial role in the Earth's climate system, yet the physical and chemical processes in the ocean and their link to climatic changes are largely unknown. The research group **Marine Isotope Geochemistry** utilizes radiogenic isotopes (neodymium, strontium) to study the provenance and transport pathways of water masses and terrigenous material and hence biologically essential trace metals contained in terrigenous sediments. The analysis of these isotopes in seawater thus provides insight into processes and water mass distributions in the present ocean, while the study of fossil marine sediments allows the reconstruction of past ocean circulation changes in the course of climate variations.

Research topics:

- dissolved and particulate Nd isotopes in seawater
- past ocean circulation and climate change
- paleoclimate reconstructions

BIOLOGY OF GEOLOGICAL PROCESSES



Head:

Diploma:

Dissertation:

Postdoctorates:

Habilitation:

ICBM joined:

Prof. Dr. Meinhard Simon

University of Freiburg (1980, Biology)

Univ. Freiburg (1985, Microbial Ecology)

Univ. Konstanz, Scripps Institution of
Oceanography, San Diego, USA

Univ. Konstanz (1992, Microbiology)

1997

Key publications:

Wagner-Döbler I et al. (2010): The complete genome
sequence of the algal symbiont *Dinoroseobacter shibae*
- a hitchhiker's guide to life in the sea. ISME J 4:61-77.

Giebel HA et al. (2009): Distribution of *Roseobacter*
RCA and SAR11 lineages and distinct bacterial com-
munities from the subtropics to the Southern Ocean.
Environ Microbiol 11:2164-2178.

Main Research:

The research interest focuses on the cycling and decomposition of organic matter in the water column and in surface sediments of the sea by microorganisms, in particular bacteria. Important questions concern the identification and characterization of these bacteria and their physiological and genetic properties as well as the significance of microbial processes on particles and suspended matter (marine snow). Classical microbiological and molecular, culture independent, as well as highly sensitive analytical methods are applied.

An important focus is on the significance of the Roseobacter clade in marine ecosystems. Several important strains of this group are subject of a comprehensive genomic analysis.

Besides investigations in the North Sea and the Wadden Sea, research cruises to the Southern Ocean, the Pacific and the Red Sea have been conducted.

PLANKTOLOGIE



Head:
Diploma: Univ. Oldenburg (1994, Biology)
Dissertation: Univ. Kiel (1999, Oceanography)
Postdoctorate: Univ. Uppsala (1999-2001)
Habilitation: Univ. Uppsala (2003, Limnology)
Professorships: Univ. Kiel, (2002-2004)
Univ. Köln (2004-2008)
ICBM joined: 2008

Prof. Dr. Helmut Hillebrand

Key publications:

Hillebrand H et al. (2007): Consumer versus resource control of producer diversity depends on ecosystem type and producer community structure. Proc Nat Acad Sci USA 104:10904-10909.
Hillebrand H (2004): On the generality of the latitudinal gradient. Am Nat 163:192-211.

Main Research:

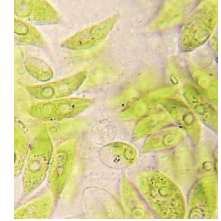
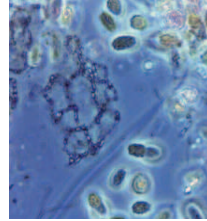
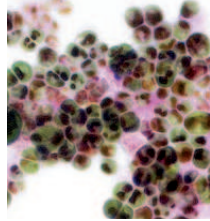
Pelagic and coastal benthic microalgae are predominant marine primary producers and represent the basis of marine food webs. The research in the plankton ecology workgroup focuses on the experimental test of general ecological hypothesis with a main emphasis on the causes and consequences of biodiversity and the structure of pelagic food webs. Anthropogenic alterations of regional climate, biochemical cycles and the loss of biodiversity in many ecosystems are motivations of our research efforts.

Important conceptual frameworks guiding our work are eco-

logical stoichiometry, metacommunity concepts and multiscale models of biodiversity regulation and consequences of biodiversity loss. Most of our studies deal with aquatic autotrophs (benthic microalgae, phytoplankton, macrophytes) and their herbivores (snails, crustaceans, insect larvae).

Our main working tools are manipulative experiments both in the field and in the lab as well as meta-analyses of large scale patterns and published literature. We strongly aim at synthesizing patterns and processes within community ecology.

PALEOMICROBIOLOGY



Head:
Diploma: Univ. Göttingen (1980, Biology)
Dissertation: Univ. Göttingen (1982, Microbiology)
Postdoctorate: Vrije Universiteit Amsterdam (1983)
Habilitation: Univ. Konstanz (1989, Microbiology and microbial Ecology)
ICBM joined: 1992

Prof. Dr. Heribert Cypionka

Key publications:

Batzke A et al. (2007): Phylogenetic and physiological diversity of cultured deep-biosphere bacteria from Equatorial Pacific Ocean and Peru Margin sediments. *Geomicrobiol J* 24:261-273.

Wilms R et al. (2007): Methane and sulfate profiles within the subsurface of a tidal flat are reflected by the distribution of sulfate-reducing bacteria and methanogenic archaea. *FEMS Microbiol Ecol* 59:611-621.

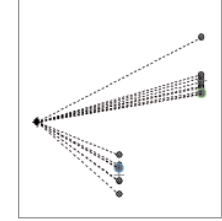
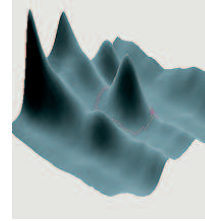
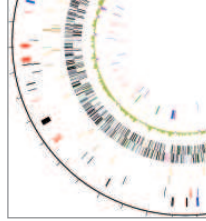
Main Research:

A large part of the living biomass on Earth exists hidden, in the so-called deep biosphere underneath the sea bottom. The Bacteria and Archaea thriving in the sediments are responsible for the biogeochemical processes in sediments. They are studied in our group by means of microbiological and molecular methods.

Research interests:

- Microbial communities and activities in sediments
- Energy metabolism under starvation
- www.microbiological-garden.net

GENERAL AND MOLECULAR MICROBIOLOGY



Head:
Diploma: LMU München (1992, Biology)
Dissertation: Univ. Bremen (1995, Microbiology)
Postdoctorate: MPI Bremen and UCSD (USA)
Habilitation: Univ. Bremen (2003, Microbiology)
ICBM joined: 2006

Prof. Dr. Ralf Rabus

Key publications:

Zech H et al. (2009): Growth phase-dependent global protein and metabolite profiles of *Phaeobacter gal-laeciensis* strain DSM 17395, a member of the marine Roseobacter-clade. *Proteomics* 9:3677-3697.

Wöhlbrand L et al. (2007): Functional proteomic view of metabolic regulation in „*Aromatoleum aromaticum*“ strain EbN1. *Proteomics* 7: 2222-2239.

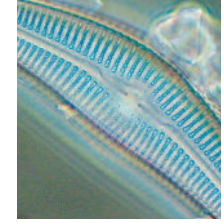
Main Research:

The **General and Molecular Microbiology Group** investigates molecular physiology of (marine) environmental bacteria. Main research interests are elucidation of novel metabolic pathways and of molecular mechanisms for the adaptation to changing environmental conditions (e.g. gradients of nutrients). The group employs an innovative-integrative approach by combining classical physiology with modern methods from genome and proteome research.

Research interests:

- Aromatic compound and hydrocarbon degradation (anaerobic) in denitrifiers (model organism *Aromatoleum aromaticum* strain EbN1) and sulfate reducers
- Carbon and energy metabolism in completely oxidizing sulfate reducers (family *Desulfobacteriaceae*)
- Physiological proteogenomics of *Roseobacter* spp.

MARINE LABORATORY



Head:
Diploma: Univ. Münster (1986, Landscape Ecology)
Dissertation: Univ. Münster (1992, Geography)
Postdoctorate: Geol. Dienst Niedersachsen, BGR
Habilitation: Univ. Hannover (2001, Palaeoclimatology and -ecology)
ICBM joined: 2004

PD Dr. Holger Freund

Key publications:

Barkowski J et al. (2009): The impact of tidal inundation on salt marsh vegetation after de-embankment of Langeoog Island, Germany - six years time series of permanent plots. *J Coast Conserv* 13:185-206.

Freund H et al. (2004): The indicative meaning of diatoms, pollen and botanical macro fossils for the reconstruction of sea-level fluctuations along the coast of Lower Saxony; Germany. *Quatern Int* 112:71-87.

Main Research:

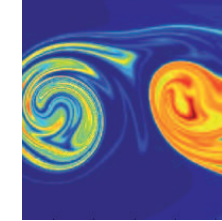
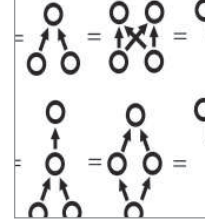
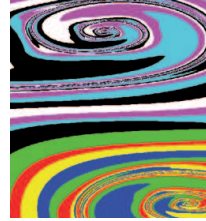
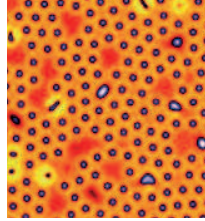
Geoecology is an interdisciplinary environmental science, dealing with natural ecosystems, their complex interactions and interrelations abundant in the environment and the human influence on this systems. Special emphasis is laid on the research of coastal bio/geo-systems and their respond to middle- and short-term sea level-, environmental- and climatic changes. The investigations carried out take place on different spatial and temporal scales. For instance, they involve the whole Quaternary (2.58 Million yrs) as well as decadal vegetation changes on a temporal scale. On a spatial scale diatom assemblages in a square centimetre are also a field of research as a de-embankment of some square kilometres.

For conducting geoecological investigations geological, sedimentological, paleoecological and botanical field and lab-methods are used.

Main research issues:

- Reconstruction of sea-level changes
- Neobiota in coastal ecosystems
- Diatom assemblages in coastal ecosystems
- Geology and biostratigraphy of the coastal Holocene

THEORETICAL PHYSICS/ COMPLEX SYSTEMS



Head:
Diploma: HU-Berlin (1981, Physics)
Dissertation: HU-Berlin (1986, Theoretical Physics)
Postdoctorate: Univ. Maryland (College Park, USA)
Habilitation: Univ. Potsdam (1996, Theor. Physics)
Heisenberg-Fellowship (1997-2000)
ICBM joined: 2000

Prof. Dr. Ulrike Feudel

Key publications:

Zahn J et al. (2008): Aggregation and fragmentation dynamics of inertial particles in chaotic flows. *Phys Rev E* 77: 055301.

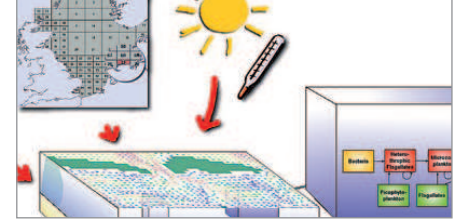
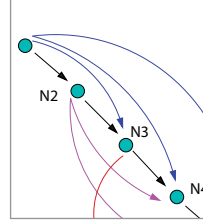
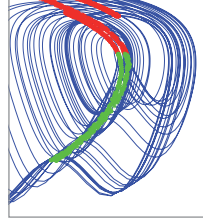
Sandulescu M et al. (2007): Plankton blooms in vortices: the role of biological and hydrodynamic time scales: *Nonlin Proc Geophys* 14:443-454.

Main Research:

The spatial and temporal dynamics of complex systems is characterized by the nonlinear interplay of the system components. In such systems, small variations in the system parameters, e.g. representing changes in environmental conditions, can under specific circumstances lead to abrupt qualitative changes in the system's response (regime shifts) or to pattern formation phenomena. In environmental systems, such regime shifts can be connected with drastic impacts on e.g. ocean currents, food webs or biodiversity.

Our particular interest in the development and analysis of mathematical models is devoted to the emergence and characterization of spatial patterns in marine sediments, the dynamics of aggregation and fragmentation of marine aggregates in tidal flats, the coupling of hydrodynamic flows with biological and chemical activity, the influence of fluctuations on regime shifts in environmental systems as well as the analysis and prediction of ecological networks.

MATHEMATICAL MODELLING



Head:
Diploma: TU Darmstadt (1993, Physics)
Dissertation: TU Darmstadt (1997, Physics)
Postdoctorate: Tel-Aviv University (Israel)
Jun. Research Group: Univ. Potsdam (2001)
ICBM joined: 2007

Prof. Dr. Bernd Blasius

Key publications:

Massie TM et al. (2010): Cycles, phase synchronization and entrainment in single-species phytoplankton populations. PNAS 107:4236-4241.
Kaluza P et al. (2010): The complex network of global cargo ship movements. J R Soc Interface doi:10.1098/rsif.2009.0495.

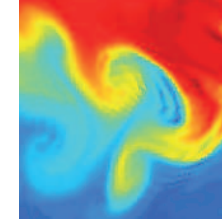
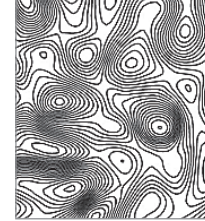
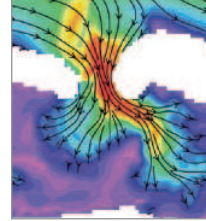
Main Research:

The interdisciplinary research group aims at a theoretical description and mathematical modeling of complex natural systems at the interface of theoretical biology, ecology, biogeochemistry, and applied mathematics. The research is focused around theoretical investigations of complex living systems, with the aim to obtain fundamental insights into their organization, but also is concerned with the translation of these concepts into concrete biological systems and tangible applications. Main working methods are numerical simulation, data analysis, and modern tools from non-linear dynamics and statistical physics.

Research interests:

- Integrative ecosystem models (e.g., tidal flat models)
- Bioinvasion and epidemic spread in complex networks
- Stability and dynamics of ecological communities
- Models of species richness and biodiversity

PHYSICAL OCEANOGRAPHY (THEORY)



Head:
Diplom:
Dissertation:
Postdoctorate:
ICBM joined:

Prof. Dr. Jörg-Olaf Wolff
Univ. Hamburg (1986, Oceanography)
Univ. Hamburg (1991, Oceanography)
MPI für Meteorology Hamburg
Antarctic CRC, Australia
(Senior Research Scientist)
1999

Key publications:

Gräwe U, Wolff J-O (2010): Suspended particulate matter dynamics in a particle framework. *Env Fluid Mech* 10: 21-39.
Gräwe U et al. (2010): Impact of climate variability on an East Australian Bay. *Est Coast Shelf Sci* 86: 247-257.
Lettmann K et al. (2009): Modeling the impact of wind and waves on suspended particular matter fluxes in the East Frisian Wadden Sea (southern North Sea). *Ocean Dyn* 59:239-262.

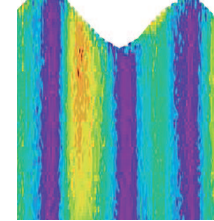
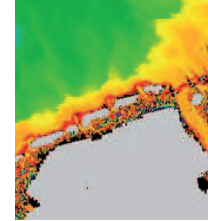
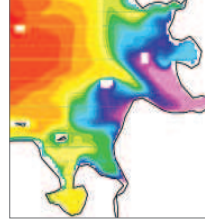
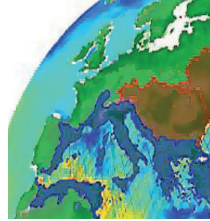
Main Research:

Physical processes in the ocean span spatial scales from millimeters to thousands of kilometers and time scales from milliseconds to millenia and beyond. We are interested in physical processes on the time and spatial scales that describe momentum fluxes in the ocean / atmosphere system, ocean / ice interaction, and hydrodynamics / morphodynamics in shelf- and coastal zones. Using modern modeling tools and diagnostics, in-situ observations, and satellite data we aim to understand physical processes at work in various environments and try to forecast real world situations.

Numerical modeling of distinct physical processes allows us to develop a fundamental theoretical understanding of the major dynamics. This theoretical understanding will give us more confidence in using earth system models including all the relevant physics to predict the evolution of the climate system in this century and beyond.

COASTAL RESEARCH

ICBM AND GKSS



Head: **Prof. Dr. Emil Stanev**
Diploma: Univ. Sofia (1972, Physics)
Dissertation: Univ. Sofia (1977, Phys. Oceanography)
Assist. Prof. and Prof.: Univ. Sofia (1977-2000, Meteorology and Oceanography)
Research associate: Univ. Oldenburg (2000-2006)
Univ. Ulster (2006-2007, Oceanography)
ICBM joined: 2007

Key publications:

Stanev E. et al. (2007): Sediment dynamics in tidally dominated environments controlled by transport and turbulence. A case study for the East Frisian Wadden Sea. *J Geophys Res*:112/C04018, doi:10.1029/2005JC003045.
Stanev E. et al. (2003): Control of Black Sea intermediate water mass formation by dynamics and topography: comparison of numerical simulations, survey and satellite data. *J Mar Res* 61:59-99.

Main Research:

The research group aims theoretically, describing, quantifying and forecasting physical and biogeochemical processes in regional seas and between continental slope and coast.

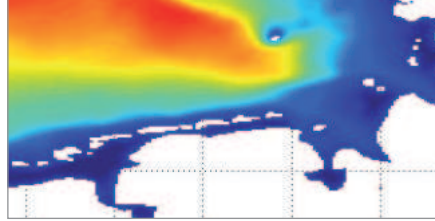
Research methods include data analysis, numerical modelling and data assimilation. Major interest is given to circulation and thermodynamics, as well as ecosystem and sediment dynamics. Improving model skills by maximising the use of available data leads to improving forecasts and state estimates, which presents

an important scientific contribution in the field of decision making and society in general.

Research Interests:

Ocean dynamics, numerical modelling of shelf and semi-enclosed seas, water cycles and water mass formation, biogeochemical modelling, sediment dynamics, air-sea exchange and atmospheric studies.

INTEGRATIVE MODELLING



Head:
Diploma: Univ. Bremen (1996, Biology)
Dissertation: Univ. Bremen (2005, Ecology)
Postdoctorate: IFZ Gießen, ICBM Oldenburg
ICBM joined: 2006

Dr. Dietmar Kraft

Key publications:

Wirtz KW et al. (2007): Oil spill impact minimization under uncertainty: Evaluating contingency simulations of the Prestige accident. *Ecol Econ* 61: 417-428.

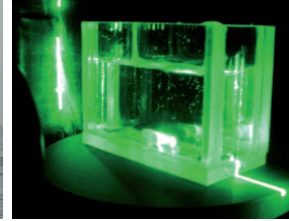
Kraft D et al. (2005): Ökologische Folgen eines Klimawandels für die Unterweser und ihre Marsch. S. 167-188 in: Schuchardt B, Schirmer M (Hrsg.): *Klimawandel und Küste*. Springer: Berlin, Heidelberg.

Main Research:

Integrative model systems are important tools for coastal research. They combine complex mathematical modelling procedures, profound expert knowledge, and extensive time series with modern information technology and problem-related evaluation methods. In the context of the thematic focus „research for a sustainable coastal zone management“, the ***Integrative Modelling Group*** was established in March 2003 by BMBF and the country of Lower Saxony as junior research group IMPULSES at ICBM. An interdisciplinary team of environmental scientists, economists, oceanographers and computer scientists work application orientated on the

development of models, software technology, and information systems dealing with the use and protection of the habitat coast. In close co-operation with other scientific institutions, authorities and the private enterprise, instruments for the management of the coast are developed. Specific examples of our work are models for hydrodynamics and particle drift as well as methods for integrative evaluation and visualization of conflict situations such as oilspills, nutrient input or offshore wind parks.

MARINE SENSOR SYSTEMS



Head: **Prof. Dr. Oliver Zielinski**
Diploma: Univ. Oldenburg (1996, Physics)
Dissertation: Univ. Oldenburg (1999, Physics)
Sensor industry: Senior Executive and CEO (2000-2004)
Professorship: Bremerhaven Univ. of Applied Science (2005-2011)
Institutional Director: IMARE Bremerhaven (2006-2011)
ICBM joined: 2011

Key publications:

Zielinski O et al. (2011): Computation of nitrate concentrations in turbid coastal waters using an in situ ultraviolet spectrophotometer. *J. Sea Res.* 65, pp. 456-460. doi: 10.1016/j.seares.2011.04.002.

Zielinski O et al. (2009): Detecting marine hazardous substances and organisms: sensors for pollutants, toxins, and pathogens. *Ocean Science* 5, pp 329-349, doi: 10.5194/os-5-329-2009.

Main research:

Innovative in-situ measuring methods are necessary to gain insights into marine processes which are influenced by long-term changes and short-term events. The group **Marine Sensor Systems** investigates and develops operational sensors to assess key parameters in coastal areas and shelf seas, integrating them into environmental sensor systems. Research interests focus mainly on spectral and imaging sensors based on optical and acoustical principles.

Research topics:

- Multispectral sensors for biogeochemical parameters and marine hazardous substances
- Autonomous long-term sensor systems and observatories
- Quality assurance and management of time series data
- In-situ imaging methods for detecting spatio-temporal distribution patterns of plankton and particles
- Description and quantification of biogeochemical-hydrodynamic exchange processes

INFRASTRUCTURE RESEARCH

In order to support the marine research, the ICBM provides an efficient infrastructure: several vessels of up to 13 m length are operated and administered. They are particularly well suited for the use in the Wadden Sea. Moreover, special construction components are produced at the Institute's own workshop for scientific questions.

In total, the ICBM uses 4,500 m² for office and labs. The equipment including analytical instruments for the geochemical and microbiological marine research is excellent. A direct access to sea water and the use of planktotrons provide the possibility for exactly simulating environmental conditions.



INFRASTRUCTURE EDUCATION

At the ICBM, teaching takes place in modern rooms and laboratories. At the campus in Wilhelmshaven, there is overnight accommodation for up to 30 people. Once the laboratories are completed, students will be able to conduct field studies on the island of Spiekeroog.

Since 1999, the ICBM has been the official training center for research divers. Up to now, more than 100 students have been trained. Qualified staff and high quality material guarantee the high standard of the training in Oldenburg.

THE **TIME-SERIES STATION** – CORE OF THE RESEARCH UNIT BIOGEOCHEMISTRY OF TIDAL FLATS

Tidal flats are an important component of coastlines affected by the tides in various climate zones and with different current conditions. They belong to the most productive ecosystems on earth and play an important role in global biogeochemical cycles.

The dynamic processes that have formed the tidal flats and continuously change them are exceedingly complex. An improved understanding of these interactions was the objective of the largest research project at ICBM, the Research Unit **BioGeoChemistry of Tidal Flats**, funded by Deutsche Forschungsgemeinschaft. Hydrodynamic, sedimentological, geochemical, and microbial processes

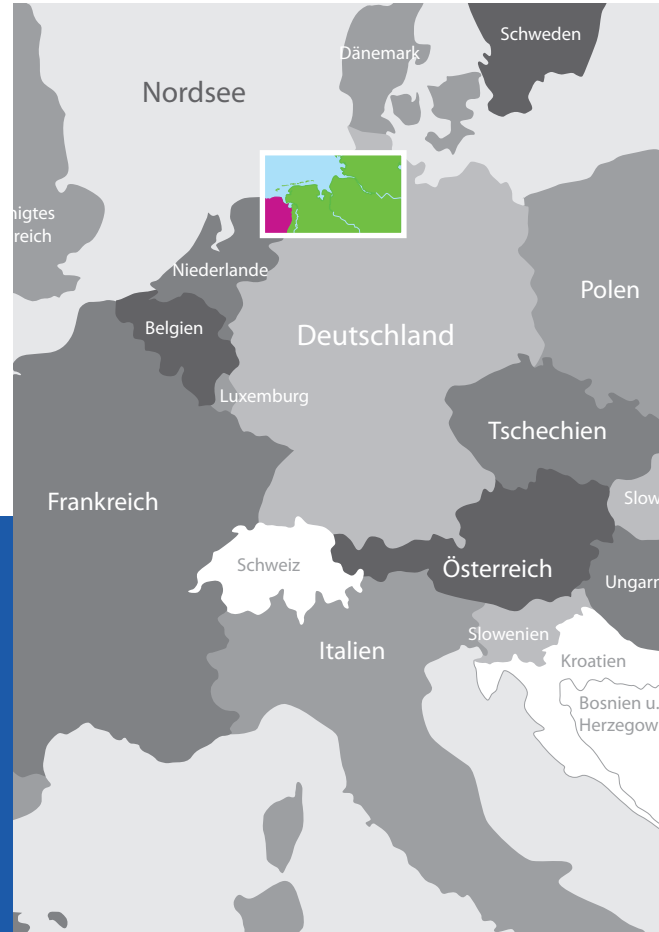
were investigated in the backbarrier tidal flats and analysed by mathematical models. The results are published in a special volume of *Ocean Dynamics* (2009), 157-427.

Ship-based studies are only possible up to wind force eight and under ice free conditions. Through the establishment of a permanent time-series station between the German islands of Spiekeroog and Langeoog in August 2002, studies of the transport of suspended material in the water column even under harsh weather conditions have become possible.



The core of the time-series station is a 35 m long tubular pole, accessible from inside and equipped with various sensors and instruments. All recorded data are transmitted wirelessly, stored in a data base and can be inspected in the internet under <http://las.physik.uni-oldenburg.de/wattstation/>

More information is available at www.icbm.de/watt/



LOCATION AND DIRECTION

Detailed directions to the institute can be found under www.uni-oldenburg.de/uni/international/