



Darwin Center for Biogeosciences | 2009

Believing as I do that man in the distant future will be a far more perfect creature than he now is, it is an intolerable thought that he and all other sentient beings are doomed to complete annihilation after such long-continued slow progress

Charles Darwin

Darwin Center for Biogeosciences

The Darwin Center for Biogeosciences seeks to perform cutting-edge science at the interface of Biology and Earth Sciences. Within the Center, over 100 scientists are studying how System Earth is working under continuously changing conditions. The Darwin Center's research mission is to understand the functioning of global, regional and local ecosystems, focusing on change and feedback at all time scales in and between biotic and abiotic components of a changing Earth.



Darwin Center for Biogeosciences

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Introduction

The Darwin Center for Biogeosciences has now entered its second phase. This collaborative center of excellence in Biogeosciences started in December 2004 with a center subsidy by NWO. Its purpose was to stimulate and strengthen biogeological research in the Netherlands, with emphasis on excellent, truly interdisciplinary research in a wide array of Biogeoscience fields.

Following a positive evaluation in 2008 by the International Advisory Board, the Darwin Center has received NWO support for a second period of four years (2009-2013). It was concluded that this virtual center is very successful and has established effective and efficient ways to promote and fund excellent research. In 2009, the number of participating institutes increased from six to seven and five new research groups are now participating in the Darwin Center. To better reflect the research of the participating groups the English name has been changed from Center for Biogeology to Center for Biogeosciences.

By the end of 2009 a total of 43 scientists were working on projects supported by the Darwin Center. The first PhD student funded by the Darwin Center (Frederike Verbruggen) defended her thesis on February 25, 2010.

While stimulating collaborative and truly interdisciplinary research in Biogeosciences within the Netherlands was a major aim during the first period, we now also aim to stimulate interactions and co-operations with foreign groups. Since 2009 international partners are allowed to participate in projects supported by the Darwin Center. During the 6th call for proposals (2009) eleven positions were funded, with co-operation of international partners. In 2010 we anticipate to support ten more positions following the 7th call.

Business summaries are provided annually by the Darwin Center with scientific accomplishments reported every second year. This annual report provides an account of the Darwin Center's activities in 2009, and discusses the policy pursued with regard to the acceptance of research proposals submitted, the procedures followed, the program proposals accepted, the participating research groups, the long-term budgets and the activities organized by the Darwin Center to promote visibility of its aims and accomplishments.

Tanja Kouwenhoven (till March 2010),
Arian Steenbruggen (till Oct. 2009) and Bas Leeflang (from Jan. 2010), Managing Directors
Jack Middelburg, Scientific Director

Darwin Research - themes

Research of the Darwin Center for Biogeosciences is within two themes, each covers a wide range of spatial and temporal scales.

Theme 1

Biogeochemical dynamics of System Earth

(Micro-) organisms govern virtually all geochemical cycles at the earth's surface and have major consequences for heat balance, water flow and sediment transport and stability, which in turn govern the dynamics of organisms and communities. An understanding of the transformation processes carried out by (micro-) organisms is consequently essential for a meaningful analysis and quantitative description of the biogeochemical dynamics of System Earth.

Organisms are subject to changing environmental conditions, but in turn may also influence environmental conditions, both in the geological past and at present.

The application of molecular techniques will deepen our fundamental understanding of the coupling between (micro-) biology and biogeochemistry. Molecular biological approaches will allow us to identify the key players in biogeochemical cycles and to study the responses of microbial communities to environmental changes. Through the combination of activity measurement and molecular tools it may be possible to link microbial activity and biogeochemical fluxes with the identity of the organisms involved. Such knowledge is essential when developing the next generation of predictive models for global and regional biogeochemical cycling.

How do climate and environmental change (warming, changes in precipitation patterns, higher N and S deposition, elevated carbon-dioxide levels) affect ecosystems and their functioning and how do changes in ecosystems feedback (via, for example, emission of climate-active gases) on climate change? Although there is some information on individual components of climate change, we have little, if any, understanding of compensating mechanisms and synergetic effects. For instance, aquatic systems are subject to elevated atmospheric carbon dioxide and global warming and we have to collect knowledge on the combined effects on organisms and ecosystems. The two-way interactions between organisms and biogeochemical cycles operate on micro-, macro-, and mega-scales. Most environmental changes imposed on ecosystems are gradual (carbon-dioxide increase, global warming etc.); yet recent and historical observations and the geological record show that gradual changes in forcing can over time result in abrupt and major (and sometimes even catastrophic) changes in community structures. It is important to identify whether tipping points exist (a certain critical carbon-dioxide level, for example) and whether these tipping points may be deduced from the geological record or from experimental and modeling studies of the coupled dynamics of biosphere-geosphere interactions.

Theme 2

Biological proxies to better achieve paleoenvironmental reconstructions

In view of the threats the world is facing in the 21st century and beyond, the major challenge of palaeo-environmental reconstruction is to gain a better understanding of the System Earth by learning from the past. In that respect essential periods are those that exhibit abrupt changes from ice-house to greenhouse or fast warming steps in an icehouse world comparable to those that we experience now. In that context the development of new proxies, in particular those that allow quantitative reconstructions, is essential.

It must be stressed that palaeo-environmental studies and related development of proxies are multidisciplinary by nature; the greatest advances are expected by combining observational, experimental and modeling research. Key proxies for marine, freshwater and terrestrial research are those that are related to the major biogeochemical cycles (C, P, N, S, O₂, Si, and Fe). Important are proxies that describe the state of the system, as reflected in physical parameters such as the vigor of ocean circulation and transport of heat. Outstanding among them are the physical reconstruction of climate and climate related parameters. Finally, proxies that describe bioproduction and the state of ecosystems (biodiversity, ecosystem stability, complexity of the web) are important as well.

Biotic proxies are traditionally based on remains of organisms, and isotopic and elemental patterns, but recently the application of molecular markers (lipids, DNA) has shown its potential. Molecular biomarkers bridge between the life and earth sciences and can therefore play a prominent role in the biogeological research. However, for a wider application of molecular markers in biogeosciences further insight is needed on the lipid composition of archaea, bacteria and eukaryotes, their specificity and the relationship with the molecular phylogeny of these organisms and their preservation potential. Moreover, this research should be combined and confronted with classical paleontological and geochemical approaches. This will not only provide a cross validation of existing and novel proxies, but also detailed, accurate reconstruction of ecosystem dynamics in the geological past.

Darwin Research groups

To carry out this 'Darwin Research', seven institutes participating in the Darwin Center (NIOO, NIOZ, RU, UU, UvA, VU and WUR) contributed a total of 20 research groups, together with their facilities. These groups consisted of the following researchers and group leaders:

Participating institutes and their research groups, leaders & members	Period
UU	
Biogeology, Paleocology Molecular paleontology: Van der Zwaan	
Prof. dr. G.J. van der Zwaan (chair in Biogeology)	since beginning - 2010
Dr. F.J. Hilgen (associate professor)	since beginning
Dr. L. Lourens (assistant professor)	since beginning
Prof. dr. J.S. Sinninghe Damsté (0.2 chair in Molecular Paleontology)	since beginning
Dr. G.J. Reichart (assistant professor)	since 2005
Biogeochemistry: Middelburg	
Prof. dr. J.J. Middelburg (chair in Geochemistry)	since 2009
Prof. P. van Cappellen (0.2 professor in Geochemistry)	since beginning
Dr. ir. C.P. Slomp (associate professor)	since beginning
Dr. P. Regnier (assistant professor)	since beginning
Dr. T. Behrends (assistant professor)	since 2007
Prof. dr. G.J. de Lange (associate professor)	since beginning
Paleocology: Lotter	
Prof. dr. A.F. Lotter (chair in Palaeocology)	since beginning
Prof. dr. H. Brinkhuis (professor)	since beginning
Dr. R. Wagner (assistant professor)	since beginning
Dr. W. Kürschner (assistant professor)	since beginning
Environmental and innovation studies: Wassen	
Prof. dr. M.J. Wassen (Chair)	since 2009
Dr. S.C. Dekker (assistant professor)	since 2009
Dr. K.T. Rebel (assistant professor)	since 2009
Dr. M. Rietkerk (associate professor)	since 2009
Landscape ecology: Verhoeven	
Prof. dr. J. Verhoeven (chair)	since 2009
Dr. G.W. Heil (associate professor)	since 2009
Dr. M.W. Hefting (assistant professor)	since 2009
Prof. dr. H.J. Laanbroek (professor)	since 2009
Dr. M. Soons (assistant professor)	since 2009
NIOZ	
Marine Biogeochemistry: Sinninghe Damsté	
Prof. dr. J.S. Sinninghe Damsté (department head; 0.8)	since beginning
Dr. S. Schouten (senior scientist)	since beginning
Dr. E.C. Hopmans (scientist; 0.8)	since beginning
Dr. L. Villanueva (tenure track scientist)	since 2009

Darwin Research groups

Biological oceanography: Herndl	
Prof. dr. G.J. Herndl (professor)	since 2009
Prof. dr. ir. H.J.W. de Baar (professor)	since 2009
Dr. C.P.D. Brussaard (senior scientist)	since 2009
Dr. F.C. van Duyl (senior scientist)	since 2009
WUR	
Terrestrial Ecosystems and Nature Conservation: Berendse	
Prof. dr. F. Berendse (chair Systems Ecology and Nature conservation)	since beginning - 2010
Dr. E. Veenendaal (associate professor)	since beginning
Dr.ir. M.M.P.D. Heijmans (Lecturer)	since beginning
Earth System Science and Climate: Kabat	
Prof. dr. P. Kabat (Chair)	since 2010
Dr. M.R. Hoosbeek (associate professor)	since 2010
Dr. L. Ganzenveld (assistant professor)	since 2010
Dr. L. Bouwman (professor biogeochemistry / RIVM)	since 2010
Dr. B. Kruijt (assistant professor)	since 2010
Dr. R. Hutjes (senior researcher)	since 2010
Microbiology: Stams	
Prof. dr. F. Stams (professor Microbiology)	since beginning
RU	
Aquatic Ecology: Roelofs	
Prof. dr. J.G.M. Roelofs (professor)	since beginning
Dr. L.P.M. Lamers (assistant professor)	since beginning
Microbiology: Jetten	
Prof. dr. ir. M.S.M. Jetten (Chair)	since beginning
Dr. J.T. Keltjens (associate professor)	since beginning
Dr. H.J.M. Op den Camp (associate professor)	since beginning
Dr. ir. M. Strous (assistant professor)	since beginning - 2010
NIOO	
Ecosystem Studies: Heip	
Prof. dr. C.H.R. Heip (director, CEME)	since beginning
Dr. K.E.R. Soetaert (senior scientist)	since beginning
Dr. F. Meysman (senior scientist)	since beginning
Microbial Ecology: Laanbroek	
Prof. dr. H.J. Laanbroek (senior scientist)	since beginning
Dr. P.L.E. Bodelier (senior scientist)	since 2008
Food web studies: Van Donk	
Prof. dr. E. van Donk (head of department)	since 2009
Dr. W. M. Mooij (senior scientist)	since 2009
Marine microbiology: Stal	
Prof. dr. L.J. Stal (head of department)	since 2009
Dr. H. Bolhuis (senior scientist)	since 2009
Dr. H.T.S. Boschker (senior scientist)	since 2009
Dr. J.C. Kromkamp (senior scientist)	since 2009

Darwin Research groups

VU	
Terrestrial biogeochemistry: Dolman	
Prof. dr. A.J. Dolman (Chair Geo-environments)	since beginning
Dr. J. van Huissteden (assistant professor)	since beginning
Paleoclimatology and geomorphology: Ganssen	
Prof. dr. D. Kroon	since beginning – 2009
Dr. G.M. Ganssen (associate professor)	since beginning
Dr. S.R. Troelstra (assistant professor)	since beginning
Terrestrial Ecology: Aerts	
Prof. dr. R. Aerts (chair System Ecology)	since beginning
Prof. dr. J. Rozema (professor)	since beginning
Dr. J.H.C. Cornelissen (assistant professor)	since beginning
UVA	
Paleoecology and Landscap Ecology: Hooghiemstra	
Prof. dr. H. Hooghiemstra (chair Paleoecology)	since 2009
Dr. B. van Geel (associate professor)	since 2009
Dr. ir. J.H. van Boxel (associate professor)	since 2009

Abbreviations:

UU	Utrecht University
UVA	University of Amsterdam
WUR	Wageningen University and Research Centre
NIOO	Netherlands Institute of Ecology
RU	Radboud University Nijmegen
VU	VU University Amsterdam
NIOZ	Royal Netherlands Institute for Sea Research

Darwin Research - programs and projects

The Darwin Center for Biogeosciences only funds multidisciplinary programs in which biologists and earth scientists collaborate. Only Darwin Center researchers can apply for funding. The 43 research projects started to date involve 32 PhD students and 5 post-docs.

Prog.nr. Program title

1010	Bacterial anaerobic methane oxidation in high temperature environments	2010	Validation of palaeotemperature proxies in marine and lacustrine systems
1020	Role of cyanobacteria in present and past biogeochemical cycling	2020	Origin and cause of Paleogene hyperthermal events
1030	The role of microbial activity in iron-deposition in wetland ecosystems	2030	Biological validation of carbonate-based proxies and application to the Middle Miocene onset of icehouse conditions and the closure of the Tethys: seasonality as a key factor
1040	Biogeological feedbacks between temperature change, hydrology, vegetation change, and the carbon cycle at high latitudes	2040	Niche engineering and the evolution of biogeochemical cycles through time
1050	The role of crenarchaeota in the marine nitrogen cycle	2050	Continental climate signals from marine sediments: validation of organic proxies based on membrane lipids of soil bacteria
1060	Carbon recycling in peat bogs, with special emphasis on the role of methanotrophic symbionts	2060	Microbial carbon fixation in past and future high CO ₂ oceans
1070	The DARWIN Azolla project – (palaeo) ecology and biogeochemistry of the freshwater fern Azolla and its importance in global biogeochemical cycles	3010	Present and past pathways for ammonium oxidation in the oxygen-depleted waters of the ocean
1080	Impact of benthic processes on biogeochemical organic carbon cycling and organic proxy records in marine sediments	3020	Double Trouble - Consequences of Ocean Acidification - Past, Present and Future
1090	The role of benthic foraminifera in the global N-cycle	3030	Plants in a low CO₂ world: proxy development for the Pleistocene plant record and reconstructed feedbacks on the carbon cycle
1100	The Darwin Phosphorus cycle project: Role of sulphate-reducing bacteria in sediment phosphorus preservation and consequences for global climate change	3040	Sensing Seasonality
1110	Anaerobic ammonium oxidation: Impact on present and past oceanic nitrogen cycling		

More information concerning the scientific content of the 'blue' programs are given in the appendix.

Program nr. Project nr.	Theme	Program coordinator Project leader	Researcher (PhD/PD)	Funding date Start	Project End
1010	1	Stams			
1011a		Stams	M. Balk (PD)	15-sep-05	15-mar-07
1011b		Stams	T. van Gelder (techn)	1-dec-06	15-sep-08
1012		Sinninghe Damsté	R.A. Gibson (PD)	15-jun-09	
1020	1 & 2	Sinninghe Damsté			
1021		Stal	J. Compaore (PhD)	1-feb-06	
1022		Sinninghe Damsté	Th. Bauersachs (PhD)	1-jan-06	31-dec-09
1030	1	Laanbroek			
1031		Laanbroek	J. Wang (PhD)	1-nov-05	
1032		Van Cappellen	S. Vollrath (PhD)	1-jan-07	
1040	1	Dolman			
1041		Dolman	F.J.W. Parmentier (PhD)	1-sep-06	
1042		Aerts	F. Keuper (PhD)	1-feb-07	
1043		Berendse	D. Blok (PhD)	15-mar-07	
1044		Lotter	M. van Hardenbroek (PhD)	1-jan-07	

Darwin Research - programs and projects

Program nr. Project nr.	Theme	Program coordinator Project leader	Researcher (PhD/PD)	Funding date Start	Project End
1050	1	Sinninghe Damsté			
1051		Jetten	S.C.M.Haaijer (PD)	1-jan-07	
1052		Middelburg	B. Veuger (PD)	1-jul-07	
1053		Sinninghe Damsté	A. Pitcher (PhD)	1-may-06	
1060	1	Jetten			
1061		Jetten	D.J. Kip (PhD)	1-feb-06	
1062		Sinninghe Damsté	J. van Winden (PhD)	1-jul-07	
1070	1	Lotter			
1071		Roelofs	M. van Kempen (PhD)	1-oct-06	
1072		Lotter/Brinkhuis	J. Barke (PhD)	1-sep-06	
1073		Reichart	E. Speelman (PHD)	15-jul-06	
1080	1 & 2	Schouten			
1081		Middelburg	L. Pozzato (PhD)	17-apr-08	
1082		Schouten	S. Lengger (PhD)	1-nov-08	
1090	1	Jetten			
1091		Jetten	L.A.M.P. van Niftrik (PD)	1-dec-08	
1092		van der Zwaan	K. Koho (PD)	1-apr-09	
1100	1	Van Cappellen			
1101		Laanbroek	A.K. Steenbergh (PhD)	1-okt-07	
1102		Slomp	V. Palastanga (PD)	1-feb-08	
1110	1 & 2	Jetten			
1111		Jetten	W.J. Maalcke (PhD)	15-feb-08	
1112		Sinninghe Damsté	D. Rush (PhD)	1-aug-08	
2010	2	Sinninghe Damsté			
2011		Sinninghe Damsté	C. Blaga (PhD)	1-nov-05	1-nov-09
2012		Laanbroek	L. Vissers (PhD)	1-oct-05	
2013		Lotter	F. Verbruggen (PhD)	1-oct-05	1-oct-09
2020	2	Ganssen			
2021		De Lange	S. Ní Fhlaithearta (PhD)	1-feb-06	
2022		Ganssen	M. Dedert (PhD)	1-mar-06	
2023		Lourens	L. Stap (PhD)	1-mar-06	
2030	2	Van der Zwaan			
2031		Reichart	J. Wit (PhD)	1-dec-07	
2032		Ganssen	-	-	
2033		Hilgen	A. Mourik (PhD)	1-sep-05	1-sep-09
2040	2	Van der Zwaan			
2041		Van der Zwaan	M. Brouwer (PhD)	15-jan-08	
2042		Middelburg	J. van Frausum (PhD)	22-nov-06	
2050	2b	Sinninghe Damsté			
2051		Stams	R. Aydin (PhD)	15-mar-07	
2052		Sinninghe Damsté	F. Peterse (PhD)	1-jan-07	
2060	1 & 2	Middelburg			
2061		De Baar	A. Hoogstraten (PhD)	1-nov-07	
2062		Middelburg	A. de Kluijver (PhD)	7-apr-08	
2063		Schouten	P. Schoon (PhD)	1-mar-08	

Darwin Research - programs and projects

Program nr. Project nr.	Theme	Program coordinator Project leader	Researcher (PhD/PD)	Funding date Start	Project End
3010	1 & 2	Sinninghe Damsté			
3011		Jetten	-		
3012		Middelburg	-		
3020	2	Reichart			
3021		Brinkhuis/Sluys	-		
3022		Reichart	-		
3023		Brussaard	-		
3024		Bijma	-		
3030	2	Kürschner			
3031		Kürschner	-		
3032		Aerts	-		
3040	2	Ganssen			
3041		Reichart	-		
3042		Bijma	-		
3043		Ganssen	-		

Call for proposals

In 2009 the 6th call was launched: the first call of the second period. The research themes of the Darwin Center have been rephrased, so that two main research themes remain. For the first time, matching was allowed with foreign money. In December four program proposals were granted. In January 2010 the 7th and last call for proposals was launched.

Process from call to funding

As before, the process from publishing a call to funding of granted programs was completed in 5 months or less. Proposals are reviewed and ranked by an external (basically non-Dutch) review panel, consisting of four to six independent experts in different fields within Biogeosciences; the expertise of the panel covers the expertise of the research groups participating in the Darwin Center. The identities of the panel members are only communicated to the Chair of the Board of the Darwin Center; the review process is anonymous.

The procedure is coordinated by the Darwin Center office. The day after the call is closed the proposals are sent by mail and courier to all panel members, who are requested to provide full reviews within two weeks. The applicants commonly have one week to write a rebuttal.

Subsequently all reviews and rebuttals are sent to the panel members, who are requested to get well acquainted with all proposals, reviews and rebuttals as a preparation for the panel meeting. The review panel meets one full day to discuss and rank the proposals on basis of formal criteria as published in the call text. The advice of the panel to the Steering Committee of the Darwin Center is based on consensus.

The Steering Committee receives the ranking and a report of the panel meeting and formulates an advice to the Board. The Board ultimately decides which program proposals will be awarded grants.

Calls in the second period

The policy to correct for thematical imbalance that was applied for the 5th call was not continued. Instead, the research themes of the Darwin Center were rephrased; this was considered adequate by the Steering Committee and the Board to overcome imbalance in the subjects of the applications. Following calls will be open to all applications complying with these two research themes.

Because of recurrent problems with matching reported by the participating research groups, the former Chair of the Board and Managing Director of the Darwin Center pleaded for less stringent matching rules. As a result, NWO-ALW allowed the Darwin Center to accept matching with foreign money for the two calls to be published during the second period. Apart from this, the matching rules remain unchanged, which means that also in the case of foreign matching the funds used for matching should be new funding

obtained by the (foreign) institute (new money; 'eerste geldstroom'). In addition, matching with foreign money can exclusively be on basis of position-position (post-post) matching, where 1 fte applied for equals 1 fte matched; this is because the Darwin Center can not allocate funding outside the Netherlands.

6th call

In the 6th call, 13 applications were submitted of which 4 made use of the option to match with foreign money. Four program proposals were awarded grants; of these, two made use of foreign matching (for details, and abstracts of the proposed research see Appendix).

With these grants 11 new positions will be funded by the Darwin Center, resulting in a total of 45 funded positions. The Steering Committee followed the advice of the review panel which proposals to fund; however, problems with foreign matching were apparent and due to inequality in duration and salaries of PhD students between the Netherlands and a number of other countries. The Steering Committee advised the Board to skip foreign matching because of these problems; or otherwise to formulate strict rules. The Board decided to allow foreign matching also in the 7th call; but to exclusively allow post-post matching with foreign post docs.

Indices of submitted and awarded programs per subtheme and call

Theme	First phase						Second phase						total	
	call 1 (2005)	call 2 (2005)	call 3 (2006)	call 4 (2006)	call 5 (2007)	call 6 (2009)	call 1 (2005)	call 2 (2005)	call 3 (2006)	call 4 (2006)	call 5 (2007)	call 6 (2009)		
Submitted														
Theme	#	positions	#	positions	#	positions	#	positions	#	positions	#	positions	#	positions
1	5	15	8	20	1	2	3	6	4*	9*	10**	29	31	81
2	7	19	0	0	3	6	1	2	1	4	3	9	15	40
total	12	34	8	20	4	8	4	8	5	13	13	38	46	121
Awarded														
Theme	#	positions	#	positions	#	positions	#	positions	#	positions	#	positions	#	positions
1	2	5	5	14	1	2	2	4	2*	5*	2*	6	14	36
2	4	11	0	0	1	2	0	0	0	0	2	5	7	18
total	6	16	5	14	2	4	2	4	2	5	4	11	21	54

= number of programs; * = also theme 2; ** = of which two are also theme 2

Overview Darwin activities 2009

Communication and collaboration is essential to the Darwin Center, not only between researchers and the office, but also with the broader scientific community and towards the more general public. Creating brand awareness is important in establishing the status of the Darwin Center within the scientific community and within Dutch society. In this light, the Darwin Center once again organized a series of well attended Darwin activities listed below.

Darwin Days

For the third time the Darwin Days were organized by the Darwin Center Office. This annual biogeoscience conference is open to all biogeologists. The aim of the Darwin Days is to promote the unique collaboration between life and earth scientists. The focus is on the Center's research topics. Lectures were given both by researchers affiliated to the Center and keynote speakers from outside the Center.

Darwin Christmas lecture

This year's Darwin Christmas Lecture was held by professor Klaas van Egmond and was titled 'Climate change as a problem of civilization'. The Darwin Christmas lecture is organized yearly to bring scientific subjects, related to the Darwin Center, to a wide audience. The Darwin Christmas lecture was organized in cooperation with de Volkskrant and the National Natural History Museum Naturalis. The entrance is free and the lecture is in Dutch.

Newsletters

Newsletter no. 11: February 2009
 Newsletter no. 12: May 2009
 Newsletter no. 13: July 2009
 Newsletter no. 14: November 2009

Urbino Summerschool

The Darwin Center provided financial and organizational support for the Urbino summerschool, the successful international summer school on paleoclimatology. The 2009 program comprised two sessions:

- from 15 to 21 July: MICOD, a multidisciplinary learning experience in Ocean Drilling Sciences and Stratigraphy of marine sediments;
- from 23 July to 5 August 2009: Past Global Change Reconstruction & Modeling Techniques.

New website: improved usability and findability

In 2009 the development of a new website was started. The new Darwin Center website, in which Darwin Center researchers, publications and projects play a key role, was launched in February 2010. All Darwin Center researchers got personal pages providing basic information such as contact information, projects and publications. Visitors will quickly be able to find information on people, publications, projects and research groups. Other new features include special buttons for target groups such as Darwin Center researchers, public and education, press and media and jobseekers. The new look and feel will give visitors from outside the Center a better idea of what research is being conducted and which leading researchers are affiliated to the Center.

Darwin year

In 2009 we commemorated the 200th anniversary of the birth of Charles Darwin, as well as the 150th anniversary of the first publication of his famous book, The Origin of Species. These two events have been celebrated not only in the Netherlands, but all over the world. To mark the Darwin Year 2009 scientific institutions, science centers, NWO, KNAW, public libraries and the media worked together to bring Darwin's legacy of ideas to the attention of the general public. These joint efforts are an initiative of the Darwin Center for Biogeosciences in cooperation with Naturalis, NEMO science center and NWO. During the year there were many exhibitions, lectures and other activities organized for the general public as well as for scientists and educational institutes.

National opening of the Darwin Year 2009

The Darwin Year 2009 was officially launched at Naturalis on 12 February. Professor Robbert Dijkgraaf performed the official opening ceremony, led by professor Bert van der Zwaan of the Darwin Center.

Symposium: Evolutionary islands 150 years after Darwin

On 12 and 13 February the symposium 'Evolutionary islands 150 years after Darwin' was organized by Museum Naturalis (Leiden). The symposium was financially supported by the Darwin Center and professor Jack Middelburg was chairman during one of the days. The meeting brought together traditional students of island biotas, experimental/theoretical community ecologists, and evolutionary biologists, to explore the role of island-biological processes in a world in which the "island processes" of isolation and dispersal are being drastically altered.

VPRO, Darwin and the Beagle

A number of Darwin scientists responded to the invitation by the VPRO (a Dutch public broadcasting corporation) to submit proposals for scientific research projects to be carried out on board the 'Stad Amsterdam'. This clipper is currently retracing Darwin's five-year voyage on HMS Beagle. During the journey, scientists will assess the current state of the Earth. The VPRO will broadcast a 40-part TV series about this voyage.

Darwin workshop 'Biochemical modeling in aquatic environments: using R as a simulation environment'

The Darwin Center supported a workshop, organized by Filip Meysman and Caroline Soetaert (NIOO-KNAW) and Caroline Slomp (Utrecht University), to be held at NIOO in Yerseke from 28 September to 2 October. The workshop was aimed at PhDs and Junior post-docs in limnology and oceanography. The number of participants was limited to 20.

Long term Budget Darwin Center

The 2004 – 2013 budget is depicted below. Already allocated funds are depicted in blue. These are the tranches of projects from programs commissioned in the first phase. Budget is also reserved for international student exchange and special project expenditures and calamities. In brown are the expenditures of the first phase of the Darwin Center and the years 2008 and 2009.

Long Term Budget Darwin Centrum for Biogeosciences (k€)

allocated funds

	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
INCOME										
NWO-ALW	500	1.500	1.500	1.000	0	1.000	1.000	500	1.000	8.000
Matching Participants	500	1.500	1.500	1.000	1.000	1.000	1.000	500	0	8.000
Total	1.000	3.000	3.000	2.000	1.000	2.000	2.000	1.000	1.000	16.000
Carry forward from previous financial	0	989	2.990	4038	3.745	2.154	1.210	1.222	452	
Budget size	1.000	3.989	5.990	6.038	4.745	4.154	3.210	2.222	1.452	
EXPENDITURE										
Darwin Center Organization:										
Staff	7	79	83	110	112	128	115	110	105	849
Peer review	0	10	6	9	8	6	8	5	0	52
Office	0	2	3	4	4	4	4	4	4	29
Audit	0	0	2	2	2	2	2	2	2	14
Accommodation	0	10	10	10	10	60	10	10	10	130
Communication	4	58	63	163	150	50	100	100	60	748
Projects 1st phase:										
Salary costs 1st call (16)	0	800	800	800	800	0	0	0	0	3.200
Material costs 1st call	0	40	40	40	40	0	0	0	0	160
Salary costs 2nd call (14)	0	0	700	700	700	700	0	0	0	2.800
Material costs 2nd call	0	0	35	35	35	35	0	0	0	140
Salary costs 3rd call (4)	0	0	200	200	200	200	0	0	0	800
Material costs 3rd call	0	0	10	10	10	10	0	0	0	40
Salary costs 4th call (4)	0	0	0	200	200	200	200	0	0	800
Material costs 4th call	0	0	0	10	10	10	10	0	0	40
Salary costs 5th call (5)	0	0	0	0	250	250	250	250	0	1.000
Material costs 5th call	0	0	0	0	13	13	13	13	0	50
Projects 2nd Phase:										
Salary costs (23)	0	0	0	0	0	1.150	1.150	1.150	1.150	4.600
Material costs						58	58	58	58	230
Special project expenditures & calamities:										
Equipment	0	0	0	0	0	22	22	22	16	82
Fieldwork	0	0	0	0	25	30	30	30	30	145
Calamities	0	0	0	0	23	12	12	12	12	71
International student exchange	0	0	0	0	0	5	5	5	5	20
Total	11	999	1.952	2.293	2.592	2.939	1.988	1.775	1.452	16.000
Budget size minus expenditure	989	2.990	4.038	3.745	2.154	1.210	1.222	452	0	

Organization

The Darwin Center is a virtual institute, consisting of twenty research groups from the following seven participating institutes:

- Utrecht University (UU)
- Netherlands Institute of Ecology (NIOO-KNAW)
- Radboud University Nijmegen (RU)
- Royal Netherlands Institute for Sea Research (NIOZ)
- VU University Amsterdam (VU)
- Wageningen University and Research Centre (WUR)
- University of Amsterdam (UVA)

Utrecht University is responsible for coordinating the cooperation between all the participants.

Board

The Board decides on the general policy of the Darwin Center. The Board of the Darwin Center consists of representatives of each of the participating institutions and is chaired by an independent person nominated by NWO/ALW. All members have equal voting rights, except for the chairman who has no vote. The Board appoints the directors.

The Board supervises the progress of the research taking place in the Darwin Center and assesses this against the background of the research plan. They will do so on the basis of a yearly report, produced by the management, that summarizes the research output, activities organised, exchange of scientists, and international contacts.

Scientific Steering Committee

The Scientific Steering Committee is composed of the leaders of the research groups, one for each of the participating institutions. Together with the Scientific Director, the Committee is responsible for the research strategy.

Management Team

The Darwin Center has a Managing Team consisting of a Scientific Director and a Managing Director. The chair of the managing team, the Scientific Director, is responsible for coordinating the activities of the Managing Team and for maintaining the contacts with the Board on the one hand, and the Scientific Steering Committee on the other. The Managing Director is responsible for the Office of the Darwin Center from which all administrative duties are performed. The Scientific Director is selected from the leaders of the participating research groups. The Directors together with the Scientific Steering Committee are responsible for taking care that quality of the centre is maintained and improved.

Darwin Center Office

The Darwin Center has a central office, which takes care of implementation, administration and communication. It is responsible for supporting the review procedures of the scientific programs, project- and financial administration, public activities, drafting annual reports, financial control, and communication and PR.

Quality assurance and International Advisory Board

Within the Darwin Center funding and projects are only then allocated if the quality of the proposed research is ranked as very good to excellent based on peer review by a review panel. This process is described under [Call for Proposals](#) in this volume and is organized by the Managing Director in such a way that the Steering Committee nor scientists are involved in any way in the selection of peers. Based on the findings of the review panel, the Steering Committee makes recommendations to the Darwin Center Board on awarding funding or not. By doing so, the Darwin Center strives for continuous improvement on the quality of its research program. In the same vein, we are very happy that a number of international peers of great reputation agreed to accept a position on the International Advisory Board. The board will advise the Center on all scientific issues.

Darwin Center for Biogeology

Board

Dr. H. Speelman (chairman)
 Prof. dr. G.J. van der Zwaan (UU)
 Prof. dr. P. van Tienderen (UvA)
 Prof. dr. B. Oudega (VU)
 Ir. C. T. Slingerland (WUR)
 Prof. dr. S.E. Wendelaar Bonga (RU)
 Prof. dr. L. Vet (NIOO)
 Prof. dr. C. Heip (NIOZ)

Scientific Steering Committee

Prof. dr. J.J. Middelburg (UU)
 Prof. dr. H. Hooghiemstra (UvA)
 Prof. dr. R. Aerts (VU)
 Prof. dr. A.J.M. Stams (WU)
 Prof. dr. M. Jetten (RU)
 Prof. dr. H.J. Laanbroek (NIOO)
 Prof. dr. ir. J.S. Sinninghe Damsté (NIOZ)

Participating Research Groups

UU	Biogeology, Paleocology, Molecular paleontology Marine Biogeochemistry Paleocology Environmental and innovation studies Landscape ecology	Van der Zwaan Middelburg Lotter Wassen Verhoeven
NIOZ	Marine Organic Biogeochemistry Biological oceanography	Sinninghe Damsté Herndl
WUR	Terrestrial Ecosystems and Nature Conservation Earth System Science and Climate Microbiology	Berendse Kabat Stams
RU	Aquatic Ecology Microbiology	Roelofs Jetten
NIOO	Ecosystem Studies Microbial Ecology Food web studies Marine microbiology	Heip Laanbroek Van Donk Stal
VU	Terrestrial biogeochemistry Paleoclimatology and geomorphology Terrestrial Ecology	Dolman Ganssen Aerts
UVA	Paleocology and Landscap Ecology	Hooghiemstra

NWO

Peer Review Panel

International Advisory Board

Prof. dr. Jelle Bijma (chair) Prof. dr. John Birks
 Prof. dr. Terry V. Callaghan Dr. Katrina Edwards
 Dr. Andy Ridgwell Prof. dr. Howard Spero

Scientific Director

Prof. dr. J.J. Middelburg

Managing Director

Dr. A. Steebruggen (till October 2009)
 Dr. T. Kouwenhoven (till end 2009)

Darwin Office

Dr. T.J. Kouwenhoven (staff)
 M.J.W. Boonstra (administration)
 Drs. S. Frieters-Lint, MSc (communication)

Appendix: Funded programs in 2009

3010 Present and past pathways for ammonium oxidation in the oxygen-depleted waters of the ocean

Applicant Prof. dr. ir. M.S.M. Jetten (Mike)
Theme 1 & 2
Funding date 12-11-09
Positions 1 PD and 1 PhD

Abstract

Nitrogen is one of the key nutrients in marine waters that may limit primary productivity. Our views on marine N-cycling have undergone significant changes due to the discovery of novel microbial processes such as anaerobic ammonium oxidation (anammox) and strong evidence for aerobic ammonium oxidation by crenarchaea in oxygen depleted ecosystems. Also in the geological past, oxygen depleted conditions may have occurred widespread in the ocean with important consequences for N-cycling. In this project we want to study the marine N-cycle under limiting oxygen conditions that mimic the oxygen-depleted zones of the present and past oceans. The ecophysiology and biomarkers of marine N-cycle organisms will be investigated under controlled conditions in the laboratory with cultures obtained in a previous joint Darwin project. Field studies will be undertaken in the coastal and open ocean ecosystems to examine relative importance of archaeal nitrification at low oxygen concentrations and to assess which microbes interact in the marine N-cycle using state of the art techniques. Microbial biomarkers will be used to understand past N-cycling. The results of this research will lead to significant new insights into the microbial roots of the global marine N-cycle and will supply new input for biogeochemical modeling.

This program contains the following projects:

- 3011** Microbial key players in the oxidation of ammonium under oxygen limitation
3012 Lipids as indicators of N-cycling in sub-oxic zones of present and past oceans

3020 Double Trouble - Consequences of Ocean Acidification - Past, Present and Future

Applicant Dr. G.J. Reichart (Gert-Jan)
Theme 2
Funding date 12-11-09
Positions 1 PD and 3 PhD

Abstract

Along with climate warming, anthropogenic CO₂ is currently causing a significant increase in ocean acidity: **Double Trouble** (Richard Feely, Barcelona 2007)! The effects of ocean acidification on marine calcifiers and plankton, as well as the marine carbon cycle are, however, poorly understood. Here we propose an integrated multidisciplinary research project by combining:

- 1 essential laboratory experiments using organisms grown under pCO₂ controlled conditions.
- 2 state-of-the-art reconstructions of ocean acidification in the geological past.
- 3 studies of the impact of ocean acidification on the marine carbon cycle.

Together this will quantify the impact of ocean acidification on calcification and feedbacks on atmospheric pCO₂. The impact of past ocean acidification on evolution and extinction will provide important constraints on the adaptation potential of marine calcifiers and non-calcifying plankton. This approach allows for determining the consequences of differential responses for the marine carbon cycle. Together, these estimates of past and future rates of change and ecosystem turnover will yield critical assessment of the tipping points in modern environments, crucial for policy makers.

This program contains the following projects:

- 3021** Double Trouble: Consequences of Ocean Acidification - Past, Present and Future - Dinoflagellate component
3022 Double Trouble: Consequences of Ocean Acidification - Past, Present and Future - Evolutionary changes in calcification mechanisms
3023 Physiologic impacts on marine calcifiers
3024 Consequences of Ocean Acidification for Phytoplankton production and losses

3030 Plants in a low CO₂ world: proxy development for the Pleistocene plant record and reconstructed feedbacks on the carbon cycle

Applicant Dr. W.M. Kürschner (Wolfram)
Theme 2
Funding date 12-11-09
Positions 2 PhD

Abstract

Changes in atmospheric CO₂ directly affect plants because it is a substrate for photosynthesis. While many experiments have documented the growth response of higher plants to elevated CO₂, these results are only of limited use for the interpretation of plant growth conditions in the Pleistocene when low CO₂ levels (<200 ppmv) prevailed for more than 90% of the time. Terrestrial palaeoclimate reconstructions based on botanical proxies do not account for the physiological effect of low CO₂. Likewise the feedbacks on the terrestrial C-cycle are poorly understood. In the present research program we propose a unique combination of growth and decomposition experiments and phylogenetic plant-mediated carbon cycling trait reconstructions with typical elements of the glacial flora at a series of subambient CO₂ concentrations. The growth experiments and phylogenetic reconstructions are carried out in order to (1) better understand the acclimation of plants to CO₂ starvation and (2) validate botanical and organic geochemical proxies to environmental conditions that persisted during the Pleistocene; (3) quantify the feedback between variations in atmospheric CO₂ during the Pleistocene and C cycling traits of plants.

This program contains the following projects:

- 3031** Validation of botanical and organic geochemical proxies in a low CO₂ world
3032 Carbon cycling traits of plants in a low CO₂ world: feedback on soils and the atmosphere

3040 Sensing Seasonality

Applicant Dr. G.M. Ganssen (Gerald)
Theme 2
Funding date 12-11-09
Positions 2 PD and 1 PhD

Abstract

Understanding the sensitivity of Earth's climate system to perturbations is one of the most important challenges mankind is facing. Records of past climate have shown that the Earth's history is punctuated by many short-term (i.e. millennial-scale) switches in climate states and associated changes in seawater temperature and chemistry. These switches have been suggested to comprise a major seasonal component. Whereas numerical modeling studies of such past climate change address the full annual cycle, geological constraints are still limited to yearly averages. Here we propose to calibrate, validate and apply planktonic foraminiferal proxies to constrain the full seasonal cycle using ecological, geochemical and paleoceanographic approaches. Within project 3041 the baseline calibration for trace metal incorporation and stable isotope fractionation (Mg/Ca ratios, as well as ¹⁸O and ¹³C) of individual foraminifera will be determined using physiological experiments. Project 3042 consists of a field calibration and validation using plankton tows, sediment traps and surface sediments. Project 3043 applies the proxy relationships for detailed reconstructions of evolution and variability in terms of seasonality during time intervals of rapid climate change of the past 50,000 years in the most seasonal climate of the world, the monsoonal system of the Arabian Sea.

This program contains the following projects:

- 3041** The biological imprint of calcification in foraminifera
3042 Validation of seasonal proxies using planktic foraminifera
3043 Seasonal extremes during rapid (sub-) millennial climate changes in the northern Arabian Sea

Credits

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