LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE

December 2005 www.loicz.org No. 36

LOICZ NEWSLETTER

The LOICZ Newsletter is produced quarterly to provide news and information regarding LOICZ activities

CONTENTS

LOICZ-IPO and Royal NIOZ: a happy, beneficial and fruitful relationship for 13 years.

By Jan de Leeuw, Han Lindeboom and Wim Mook

Royal NIOZ, PO Box 59, 1790 AB Texel, the Netherlands

During the second half of 1992, several meetings and subsequent correspondence between John Marks of the Ministry of Education, Culture and Science (OCW), the late Henk Postma chairing IGBP-Netherlands on behalf of the Royal Netherlands Academy of Sciences (KNAW) and Wim Mook, director of the Netherlands Institute for Sea Research (NIOZ) resulted in an offer to host the International Project Office of LOICZ (LOICZ-IPO) at NIOZ on the island of Texel, the Netherlands. This offer was announced and formally accepted at the IGBP meeting in Ensenada, Mexico at the end of January 1993. It is worthy to note that the decision to fund the first five years of the IPO by three Dutch ministries, the Netherlands Organization for Scientific Research (NWO) and NIOZ was made at the very last minute, i.e. during the Ensenada meeting! That last minute decision turned out to be symbolic for the funding of the LOICZ-IPO throughout the 13 years it has been hosted at NIOZ: every time funding had to be continued major efforts by representatives of NWO and NIOZ were required and formal funding for the last period came only one year after the actual continuation of the Project office.

The first "Office manager" of the Project Office was John Pernetta who was a much involved and very hard working person who managed to establish a solid Core Office in a very short time. He is remembered for his perfect filing system, his implementation plan - known as the Pernetta bible, his cooking capabilities, his moods and personal views, his extravagant waistcoats and the weekly visits to the local Chinese restaurant together with Wim Mook. During this first phase of LOICZ-IPO, Paul Boudreau joined the office as an advanced data manager. He too was very dedicated to LOICZ, but discovered that to put the whole coastal world in one database is a very tricky if not impossible task.

After a short interim period with Roy Siddle, Chris Crossland and Hartwig Kremer took over the LOICZ office as Chief Executive Officer and Deputy Executive Officer respectively. They too were very dedicated to the LOICZ mission, did an excellent job, worked like hell, were continuously suffering from jetlag and on top of that managed to generate substantial additional funding for interesting coastal projects. After Chris and his wife Jan, who also worked part time for the Core Office, decided to return to their homeland down under, it was clear for everybody except himself, that Hartwig was going to be the new Chief Executive for the last phase and transition of LOICZ at NIOZ. Later on, he was assisted by Martin Le Tissier, who acted as his deputy.

During all these years the secretariat of the LOICZ-IPO has been efficiently and effectively supported by Sheila Lunter, Cynthia Pattiruhu, Mildred Jourdan and Hester Whyte who, with their major involvement, willingness to work day and night wherever on this planet and of course their superb professionalism the LOICZ mission was fulfilled. Without their enormous dedication, the success of LOICZ and its IPO could not have been realized.

The relationship of the office with the Scientific Steering Committee (SSC) of LOICZ has always been good and efficient, in particular during the period when Han Lindeboom was chair of the SSC, because Han worked at NIOZ and daily contacts were very helpful to keep the LOICZ machine running smoothly.

Over the years the relationship of the LOICZ-IPO with NIOZ as its host has been very good on all levels. Since NIOZ was the official employer of the LOICZ personnel, the LOICZ team was an integral part of the NIOZ community. And although their activities sent them abroad very often, they were always welcomed home when returning.

GLOBAL IGBP CHANGE

A core project of the
International Geosphere-Biosphere Programme and the
International Human Dimensions Programme on Global Environmental Change

IHDP

Through the IPO, NIOZ increasingly participated in LOICZ programs and activities, leading to more research both in Dutch coastal areas and elsewhere. The many informal contacts between other NIOZ personnel and LOICZ employees led to many fruitful discussions and ideas for new exciting projects. These contacts also covered a wide array of issues ranging from purely scientific advice, very practical technical and logistic support to human interactions of all kinds.

Although the actual mutual benefits of all these interactions are difficult to measure, we are sure that the long term presence of the IPO has contributed significantly to NIOZ coastal research and the functioning of the LOICZ project.

We are very pleased that Germany is willing to take over the LOICZ-IPO flag and we hope and expect that their future host-guest relationship will be as fruitful as our relationship over the last thirteen years.

Highlights of Dutch Coastal Zone Research

The DUTCH-LOICZ research programme was initiated several years after the LOICZ-IPO was established at the Royal NIOZ, funded by NWO and has funded a broad spectrum of Netherlands focussed research. The papers presented in a special sessions during the recently held Inaugural Open Science meeting of the new LOICZ dedicated to this research initiative highlighted the breadth of the programme.

Carlo Heip, Jack Middelburg, Karline Soetaert, Peter Herman and Britta Gribsholt (Centre for Estuarine and Marine Ecology, Netherlands Institute of Ecology, Yerseke, The Netherlands) summarized our current knowledge of the Western Scheldt estuary that drains the Scheldt river into the North Sea and which is one of the best studied estuarine systems in the world. Its history is well documented and reflects the interplay of political, religious and economic developments with the dominant physical processes, storms, sea level rise and the tidal energy from the North Sea over the last 2000 years. Most of the changes in geomorphology of the estuary are directly or indirectly due to human activities. The Scheldt drainage basin covers three countries France, Belgium and The Netherlands covering one of the most highly industrialised and densely populated areas in Europe and the impact of changes has implications not just for human uses of the estuary but also the application of the EU Birds and Habitat directives that strengthen the conservation potential for the area.

Coastal morphodynamics is never far from coastal research in the Netherlands, and **Piet Hoekstra** (Utrecht University, Institute for Marine and Atmospheric Research IMAU) described how this has now become a multidisciplinary science with contributions from coastal and marine geology, coastal oceanography, physical geography, civil and coastal engineering and marine biology and ecology. **Riks Laanbroek** (NIOO – KNAW Centre for Limnology & Utrecht University, Section of Landscape Ecology) showed how ammonia-oxidising bacteria play an important role in the global nitrogen cycle by converting ammonia to nitrite. **Frank van Kouwen** (Utrecht University dept. of Geography) described how Decision Support Systems (DSSs) will become important in the development of a sustainable and integrated approach to coastal management.

Not directly involved in Dutch LOICZ but a Dutch science highlight addressing tools for the science policy interface was presented by **Han Lindeboom** and **Erik Meesters** (Alterra-Texel, The Netherlands). Their paper introduced a new integration, management and modelling tool - called - EMIGMA (Effect Modelling of Indicators, usaGe and MAnagement) - that can be used to integrate the outcome of monitoring programs and scientific research projects and at the same time develop managerial advises which are soundly based on the actual developments of the marine realm. This tool addresses the problem of reconciling the complex interplay between natural and human induced driving forces that determine the nature of the marine ecosystem. The tool has applications for traditional uses such as fisheries, shipping, oil and gas extraction and beach nourishment, and the impact of eutrophication and pollution and the development of large windmill parks. The call to establish Marine Protected Areas puts an increasing pressure on the Dutch coastal zone and this new tool, if applied at appropriate scales, offers a method to establish the effectiveness of managerial measures.

The following two articles highlight in more detail some of the scientific achievements of the DUTCH-LOICZ programme.

Long-term ferry observations in the Marsdiep tidal inlet

By Herman Ridderinkhof

Royal NIOZ, PO Box 59, 1790 AB Texel,
the Netherlands, e-mail: rid@nioz.nl.

Introduction

In a cooperation between Royal NIOZ and the ferry company TESO (Texels Eigen Stoomboot Onderneming) long-term oceanographic observations from the ferry ‘Schulpengat’ that crosses the Marsdiep tidal inlet between den Helder (mainland) and Texel (westernmost barrier island of the Dutch Wadden Sea) are carried out. The ferry is equipped with a throughflow system for temperature and salinity observations and an ADCP that measures the current field below the ferry. The ferry crosses the Marsdiep tidal inlet each 30 minutes daily from 06.00 to 22.00 hrs, thereby resolving tidal variability. The width of the inlet that the ferry crosses in 15 minutes is about 4 km and the maximum depth is some 30 m. The observations are used to inform the general public by displaying the observed data directly on a screen in the passenger’s lounge and to study the variability in oceanographic parameters and fluxes in this tidal inlet. Some results of the scientific analyses are discussed in this note.

Currents

Figure 1 shows typical examples of the depth-averaged currents around maximum flood, maximum ebb and of the tidally averaged currents.Tidal currents reach maximum values of around 1.5 m s^{-1}, with strongest currents in the deepest central part of the inlet. The strength of the tidal mean currents is about 10% of the tidal currents and has a large spatial variability even over the relatively short distance of the inlet. At the northern site of the inlet the mean currents are outward (towards the adjacent North Sea) and at the southern site the currents are inward. The influence of wind or river inflow on these tidal mean currents appears to be relatively weak because they are mainly caused by the interaction between the tidal currents and topography.

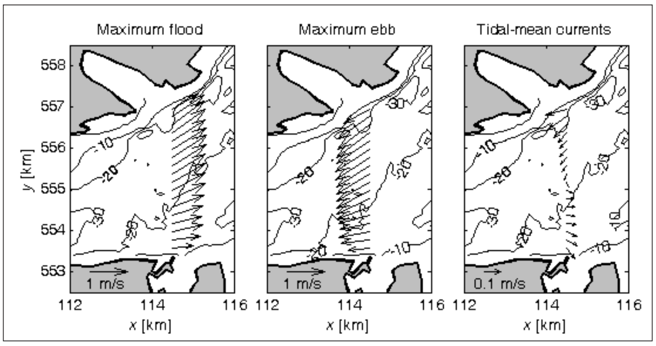

Figure 1. Typical examples of the depth-averaged tidal and mean currents in the Marsdiep inlet as observed with the ferry-ADCP on the route den Helder-Texel.

By integrating the measured vertical profiles over each transect a more or less synoptic dataset on the water transport through the entire inlet was obtained. A harmonic fit, using 67 tidal components was applied to analyse this data set. Figure 2 shows the results for a period of 5 years (1998-2002). The top of the figure shows the harmonic fit of the data and the bottom shows the original data (black dots), the harmonic fit (blue line) and the difference between both (red dots) for a representative number of days. Further analyses showed that the variability in the remaining signal (red dots) can largely be explained from variability in wind speed and direction. For such a type of analyses of the variability in water transport it is essential that the data set has a high frequency and a long duration enabling the determination of relatively high- and low- frequency tidal components. Here the period of the tidal components that was used in the analysis varied between about 2 hours and one year.

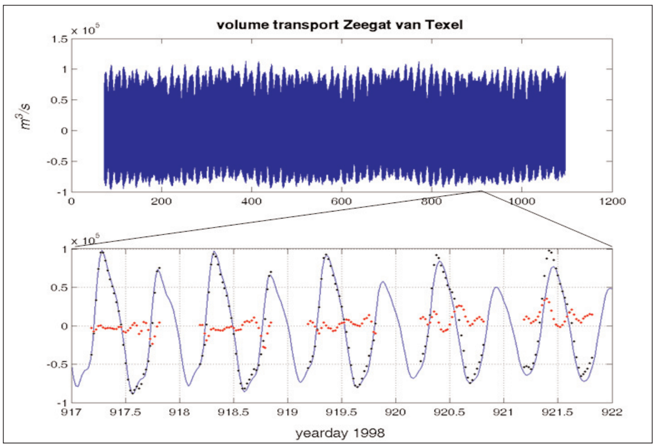

Figure 2. Water transport through the Marsdiep tidal inlet between the North Sea and Wadden Sea as determined from the long term ADCP observations. The top panel shows the harmonic fit to the data for a period of about 4 years, the bottom panel shows a typical example of the original data (black dots), the harmonic fit (blue line) and the difference between both for a period of 6 days.

Suspended sediments

In principle, the observations on acoustic backscatter from the ADCP can be used also to obtain insight in the suspended sediment concentration (SSC) in the tidal inlet. However, studies on variability in SSC critically depend on the translation of the acoustic backscatter signal to SSC values. The classical model assumes that EI ~ log (SSC), where EI (dB) is the echo-intensity of the backscattered signal. Calibration experiments that were done in the framework of the LOICZ project showed that this relation appeared to give very poor results especially for strong currents (stronger than 0.7 m s^{-1}). Moreover, variability in the size and quality of the suspended material could not explain the failures of the classical model.

Therefore, the classical model has been extended to develop a novel model that includes the effect of acoustic backscatter enhanced by coherence in the particles' spatial distribution as a result of turbulence-induced sediment fluctuations (Figure 3).

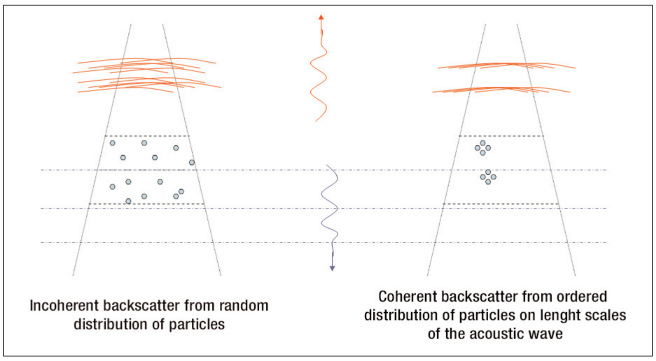

Figure 3. Sketch of backscatterance in the classical model (left side) and in the extended model (right side)

A theoretical derivation (Merckelbach, 2005) showed that in strong currents the relation between EI and SSC changes to EI ~ log (SSC^2). This relation was compared with a number of detailed observations obtained during field surveys to calibrate the ferry observations (Merckelbach & Ridderinkhof, 2005). It was shown that the extended model gives a large improvement of the estimated SSC and can be used to apply to the ferry data set to analyse suspended sediment transport through the Marsdiep tidal inlet.

The first application of the new model to the ferry–ADCP dataset to 2003 data (Figure 4) shows the monthly mean absolute value of the flux of suspended sediments through the Marsdiep tidal inlet, divided between flood and ebb periods. The difference between both indicates the net flux. There appears to be a relatively large net flux of suspended sediments towards the Wadden sea. Moreover, this flux is substantially larger during spring and early summer, as compared to the other periods suggesting that biological processes play an important role in influencing the magnitude of this net flux (Ridderinkhof & Merckelbach, 2006).

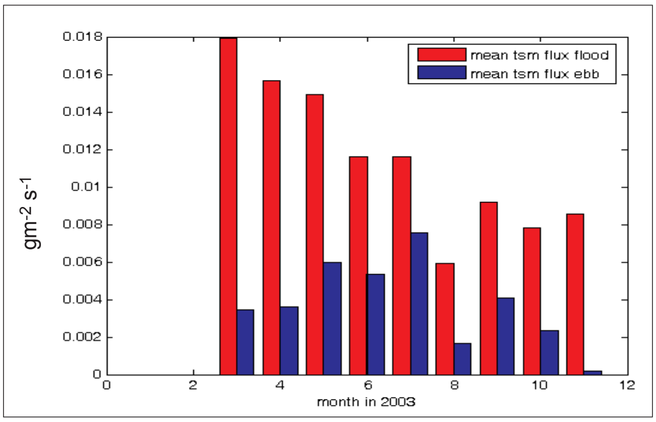

Figure 4. Mean absolute value of the flux of suspended sediments through the Marsdiep tidal inlet, averaged over the flood (red) and ebb (blue) tide, from March 2003 (month 3) till November 2003 (month 11)

Temperature and salinity

Temperature (T) and salinity (S) variations across the inlet are largely dominated by tidal variations, such as current.

Figure 5 illustrates this by showing the cross-sectional averaged T- and S- values for 2 days of observations.

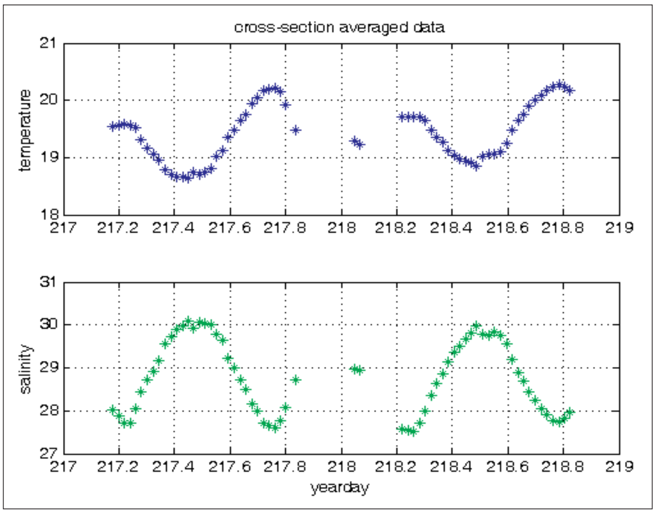

Figure 5. Cross-section averaged salinity and temperature in the Marsdiep tidal inlet for a period of 2 days.

The tidal influence on these observations is clear. Salinity increases during flood when saltier water from the adjacent North Sea enters the Wadden Sea through the tidal inlet and decreases during ebb tides. A similar variability is seen in temperature variations. Both show that differences in T and S between the Wadden Sea and North Sea can be large and these data can be used to study variations in the induced longitudinal density gradient across the tidal inlet.

Longer term variability in the salinity observations is shown in Figure 6 where daily averaged values (top) and the daily standard deviation (bottom) are shown for a typical year. Salinity values are lowest in winter and spring when the input of fresh water into the coastal zone from the rivers in largest. A relatively low mean salinity coincides with relatively high daily variability in salinity values. Thus, as expected, salinity differences between the North Sea and Wadden Sea are largest when the input of fresh water to the coastal zone is largest.

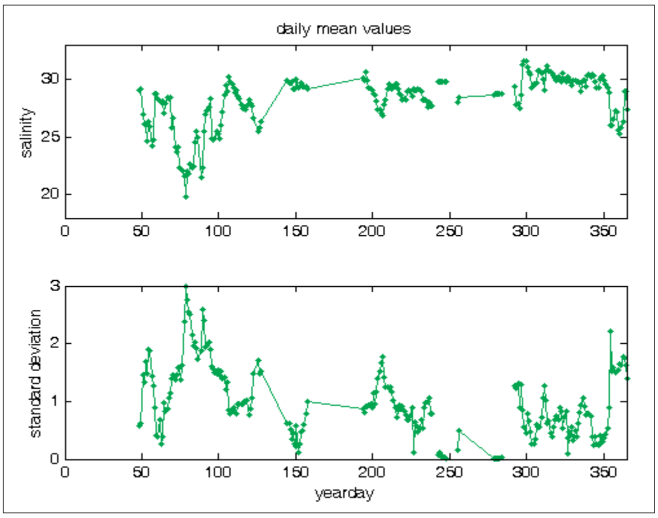

Figure 6. Daily averaged salinity (top) and daily standard deviation (bottom) in the Masdiep tidal inlet for a period of one year.

References

L.M. Merckelbach, 2005. A model for high-frequency acoustic Doppler current profiler backscatter from suspended sediments in strong currents. Submitted to Cont. Shelf Res.

L.M. Merckelbach and H. Ridderinkhof, 2005. Estimating suspended sediment concentration using backscatterance from an acoustic Doppler profiling current meter at a site with strong tidal currents. Accepted for publication in Ocean Dynamics.

H. Ridderinkhof & L. Merckelbach, 2006. Suspended sediment fluxes through the Marsdiep tidal inlet from long-term ferry-ADCP observations. In prep.

Terrestrial organic matter input in the coastal system as revealed by tetraether membrane lipids

By Lydie Herfort, Jan P. Boon, Stefan Schouten, Martijn Woltering, Marianne Baas and Jaap S. Sinninghe Damsté

Department of Marine Biogeochemistry & Toxicology,
Royal Netherlands Institute for Sea Research (NIOZ),
P.O. Box 59, 1790 AB Den Burg, Texel, The Netherlands.
* Corresponding author e-mail Herfort@nioz.nl.

Although rivers provide large amounts of organic carbon to the marine environment (ca. $4x10^{14}$ g C year^{-1}; Schlesinger and Melack 1981), the importance and fate of terrestrial organic matter (TOM) in the ocean remains one of the major uncertainties of the global carbon cycle. Several methods have been developed to resolve this problem, such as analysing the C/N ratio and the ^{13}C content of bulk organic matter, or the use of higher plants-derived biomarkers, but none are truly satisfactory (see Pancost and Boot 2004 and Hedges et al. 1997 for details).

Recently, using 2D NMR techniques we have identified the structure of a group of branched glycerol dialkyl glycerol tetraethers (GDGT) isolated from Dutch peat (Sinninghe Damsté et al. 2000). Pilot studies suggest that these GDGTs may be used as a indicator for TOM input in the coastal environment as they are found abundantly in peats and soil, and to a lesser extant in coastal marine sediments, but not in open ocean sediments. Hopmans et al. (2004) have presented a novel proxy, the so-called Branched and Isoprenoid Tetraether (BIT) index, based on the relative abundance of crenarchaeol, an isoprenoid GDGT considered as a specific biomarker for the marine Crenarchaeota group I belonging to the archaeal domain (Sinninghe Damsté et al. 2002; Schouten et al. 2000; Powers et al. 2004), and that of the branched GDGTs which are synthesised by terrestrial Bacteria (Weijers et al. in press). BIT index values range from 0, in sediments containing exclusively organic carbon of marine origin, to 1 in samples with no crenarchaeol and, therefore, comprising only terrigenous carbon.

In a Dutch LOICZ project (funded by the Dutch Organization for Scientific Research), TOM transport into the Southern North Sea was determined using the BIT index. Although it is well known that the Southern North Sea is strongly influenced by river discharges, several studies have suggested that the resulting high freshwater input is not associated with important TOM addition to the marine environment (Salomons and Mook 1981; Megens et al. 2001). As the Rhine/Meuse is the most important river system flowing into this area, water sampling was also carried out in the Rhine. Sampling was carried out in the Southern North Sea at eight stations during three cruises in February 2003, April 2004 and August/September 2004 and in the Rhine at three locations in February 2005 and September 2006 (Figure 1).

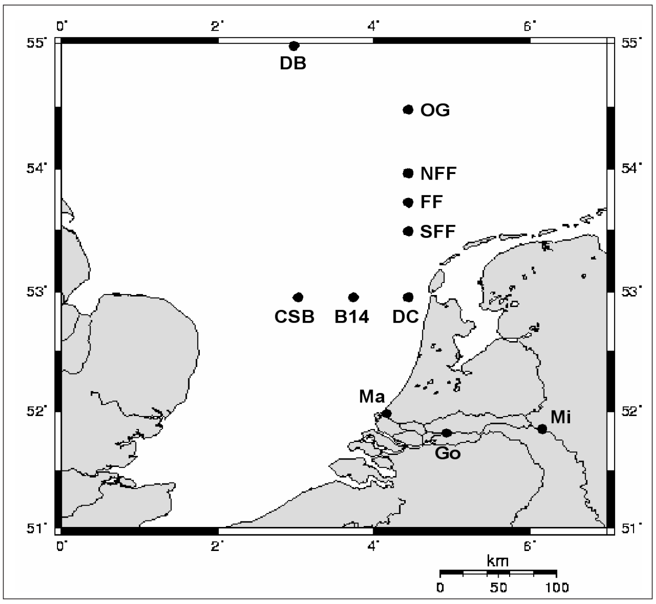

Figure 1. Map showing the location of the study sites in the Southern North Sea and the river Rhine. Abbreviations = DC: Dutch Coast; CSB: Central Southern Bight; B14: Breeveertien; SFF: South Frisian Front; FF: Frisian Front; NFF: North Frisian Front; OG: Oyster Grounds; DB: Dogger Bank; Ma: Maassluis; Go: Gorinchem; Mi: Millingen.

The detection of branched GDGTs in suspended particulate organic matter in surface seawater demonstrates the presence of TOM in the Southern North Sea. Furthermore, elevated BIT indices were associated with low salinity values (Table 1), suggesting that the BIT index may be good tracer for TOM input in the coastal environment.

High concentrations of branched GDGTs were detected at both seasons in the water of the river Rhine. With an average concentration of 33 ng l^{-1}, the branched GDGTs were 20 times more abundant in the Rhine than at the site of the Southern North Sea with the highest concentration (Dutch Coast: 1.6 ng l^{-1}; Table 1). This confirms that branched GDGTs are transported from soils and peats to the marine environment via rivers.
Although much lower than that of branched GDGTs, the concentration of crenarchaeol measured in the Rhine was higher than in the Southern North Sea. This result was unexpected as it is traditionally thought that crenarchaeol is a specific biomarker for the marine group I Crenarchaeota and that those are not abundant in soils and peats (Weijers et al. 2004). So, input of crenarchaeol from soils and peats cannot account for the high lipid concentration measured in the Rhine. Crenarchaeota have been detected in rivers (Abreu et al. 2001), but molecular analysis did not reveal higher Crenarchaeota concentrations in the Rhine than in the Southern North Sea (data not shown). Hence, the Crenarchaeota living in the river cannot account alone for the high crenarchaeol concentrations measured in the Rhine. Crenarchaeol has been detected in the surface sediments of a large number of lakes distributed all over the world (Powers et al. 2004) and also the Rhine may receive a constant input of crenarchaeol from lacustrine origin may thus explain the high crenarchaeol concentration measured in the river.

The resulting BIT indices in river water were high, with an average value of 0.84 that was 3 times higher than the highest value obtained in the Southern North Sea (Dutch Coast: 0.25; Table 1). However, the relatively high crenarchaeol concentration measured in the river Rhine affected the BIT index, generating a value below the theoretical terrestrial value of 1. This was not a seasonal effect as all measurements gave BIT indices below 0.9. This agrees with recent findings by Weijers et al. (In press) who calculated the BIT indices of soils from widely distributed locations and found an average of 0.91. So, clearly values below 1 can also characterize a terrestrial environment. This underlines that, as previously stressed by Hopmans et al. (2004), this new proxy gives a relative measure of TOM transport and should not be used as an absolute quantity. This also implies that instead of the originally defined range of the BIT index as pure marine to pure terrestrial it would be more accurate to describe it as from terrestrial environments containing exclusively branched GDGTs (and thus no crenarchaeol) to aquatic environments dominated by crenarchaeol sources.

References

Abreu, C., G. Jurgens, P. De Marco, A. Saano, and A. A. Bordalo 2001. Crenarchaeota and Euryarchaeota in temperate estuarine sediments. J. Appl. Microbiol. **90**: 713-718.

Hedges, J. I., R. G. Keil, and R. Benner 1997. What happens to terrestrial matter in the ocean? Org. Geochem. **27**: 195-212.

Hopmans, E. C., J. W. H. Weijers, E. Schefuß, L. Herfort, J. S. Sinninghe Damsté, and S. Schouten 2004. A novel proxy for terrestrial organic matter in sediments based on branched and isoprenoid tetraether lipids. Earth Planet. Sci. Lett. **224**: 107-116.

Megens, L., J. van der Plicht, and J. W. de Leeuw 2001. Temporal variations in 13C and 14C concentrations in particulate organic matter from the southern North Sea. Geochim. Cosmochim. Acta **65**: 2899-2911.

Pancost, R. D., and C. S. Boot 2004. The palaeoclimatic utility of terrestrial biomarkers in marine sediments. Mar. Chem. **92**: 239-261.

Powers, L. A., J. P. Werne, T. C. Johnson, E. C. Hopmans, J. S. Sinninghe Damsté, and S. Schouten 2004. Crenarchaeotal membrane

		Salinity (PSU)				Crenarchaeol (ng l^{-1})				Branched GDGTs (ng l^{-1})				BIT index			
		Feb.	Apr.	Aug.	Sept.	Feb.	Apr.	Aug.	Sept.	Feb.	Apr.	Aug.	Sept.	Feb.	Apr.	Aug.	Sept.
Location	*Stations*																
North Sea	DC	29.7	32.1	32.8		5.0	0.6	0.5		1.6	n.d.	0.1		0.25	n.d.	0.17	
	B14	33.7	35.0	34.8		n.a.	0.9	0.2		n.a.	n.d.	n.d.		n.a.	n.d.	n.d.	
	CSB	34.3	34.7	34.3		6.3	6.9	1.3		0.3	0.2	0.1		0.04	0.02	0.06	
	SFF	30.7	34.8	34.2		0.8	2.1	0.5		0.2	0.1	0.1		0.18	0.03	0.13	
	FF	31.9	34.6	34.0		2.4	5.3	1.6		0.5	0.1	0.2		0.16	0.03	0.10	
	NFF	34.2	34.8	34.7		0.5	0.6	0.4		n.d.	n.d.	n.d.		n.d.	n.d.	n.d.	
	OG	34.6	34.8	34.6		1.7	0.2	0.1		0.1	n.d.	n.d.		0.07	n.d.	n.d.	
	DB	34.6	35.0	34.9		0.8	0.4	0.3		0.1	n.d.	n.d.		0.08	n.d.	n.d.	
Rhine	Ma	1.9			6.0	8.1			1.2	23.5			5.6	0.74			0.82
	Go	1.0			1.0	6.5			4.4	52.3			34.7	0.89			0.89
	Mi	0.7			1.0	10.7			4.2	46.0			35.6	0.81			0.90

Table 1 - Salinity values, branched GDGT and crenarchaeol concentrations, and BIT indices for eight stations in the Southern North Sea and three locations in the river Rhine. Station abbreviations are given in the caption of Figure 1.

lipids in lake sediments: A new paleotemperature proxy for continental paleoclimate reconstruction? Geology **32**: 613-616.

Salomons, W., and W. G. Mook 1981. Field observations of the isotopic composition of particulate organic carbon in the southern North Sea and adjacent estuaries. Mar. Geol. **41**: M11-M20.

Schlesinger, W. H., and J. M. Melack 1981. Transport of organic carbon in the worlds rivers. Tellus **33**: 172-187.

Schouten, S., E. C. Hopmans, R. D. Pancost, and J. S. Sinninghe Damsté 2000. Widespread occurrence of structurally diverse tetraether membrane lipids: Evidence for the ubiquitous presence of low-temperature relatives of hyperthermophiles. Proc. Natl. Acad. Sci. USA **97**: 14421-14426.

Sinninghe Damsté, J. S., E. C. Hopmans, R. D. Pancost, , S. Schouten, J.A.J. Geenevasen 2000. Newly discovered non-isoprenoid glycerol dialkyl glycerol tetraether lipids in sediments. Chem. Commun. **2000**: 1683-1684.

Sinninghe Damsté, J. S., W. I. C. Rijpstra, E. C. Hopmans, F. G. Prahl, S. G. Wakeham, and S. Schouten 2002. Distribution of membrane lipids of planktonic Crenarchaeota in the Arabian sea. Appl. Environ. Microbiol. **68**: 2997-3002.

Weijers, J. W. H., S. Schouten, M. van den Linden, B. van Geel, and J. S. Sinninghe Damsté 2004. Water table related variations in the abundance of intact archaeal membrane lipids in a Swedish peat bog. FEMS Microbiol. Lett. **239**: 51-56.

Weijers, J. W. H., S. Schouten, E.C. Hopmans, J.A.J. Geenevasen, O.R.P. David, J.M. Coleman, R.D. Pancost and J. S. Sinninghe Damsté In press. Membrane lipids of mesophilic anaerobic bacteria thriving in peats have typical archaeal traits. Environmental Microbiology.

The North American Nitrogen Center

By Dennis P. Swaney[1] and Robert W. Howarth[2]

[1] Boyce Thompson Institute for Plant Research, Tower Road, Cornell University, Ithaca, NY 14853, USA, e-mail: dps1@cornell.edu.

[2] Department of Ecology and Evolutionary Biology, Cornell University, E311 Corson Hall, Ithaca, NY 14853, e-mail: rwh2@cornell.edu.

Earlier this year LOICZ agreed a memorandum of understanding to cooperate with the North American Nitrogen Center (NANC) on educational and research issues related to nitrogen in the environment. So, what is the NANC and how will it interact with LOICZ?

The NANC is the North American node of the International Nitrogen Initiative (INI) and was established in 2004 at Cornell University in Ithaca, New York, USA under the direction of Bob Howarth with 4 overall goals:

- To better assess the sources of nitrogen pollution and drivers of change in nitrogen cycling across the regions of North America, with an emphasis on evaluating trends in fluxes and environmental exposure.
- To comprehensively and quantitatively assess both the ecological and human health consequences of nitrogen pollution in North America.
- To develop policy options for reducing nitrogen pollution and to encourage large scale pilot studies to test potential policies and technical solutions.
- To communicate the issues arising from human acceleration of the nitrogen cycle to the public and decision makers, and facilitate communication and interaction within the scientific community.

An example of research directed at the first goal is the development of a methodology to estimate net anthropogenic nitrogen inputs (NANI) into watersheds and relate them to corresponding nitrogen fluxes from the watersheds. NANI includes 4 categories of nitrogen: fertilizer use, nitrogen fixation in agricultural and forest lands, atmospheric deposition into the watershed, and nitrogen content of net food and animal feed fluxes into the watershed. For 16 watersheds in the Northeastern USA (Figure 1a, b), NANI has been related to average riverine N fluxes over the period 1988-93 (Boyer et al., 2002). Similar analyses are being pursued for some European watersheds.

The NANI methodology originates from the International SCOPE nitrogen project and is being extended by using its load estimates in a hydrological-based model (the Regional Nutrient Management model, ReNuMa) to simulate seasonal and annual streamflow and nitrogen fluxes (Figure 2). Across these watersheds, total annual riverine N and simulated annual DIN fluxes vary in response to the magnitude of N inputs. The magnitude of nitrogen inputs, as well as their major components, vary significantly across the region, from atmospheric deposition-driven watersheds of the north, to urban watersheds with large wastewater loads and southern watersheds with relatively large agricultural sources of N. Nitrogen retention processes in the landscape, including denitrification, are responsible for the difference between inputs and outputs.

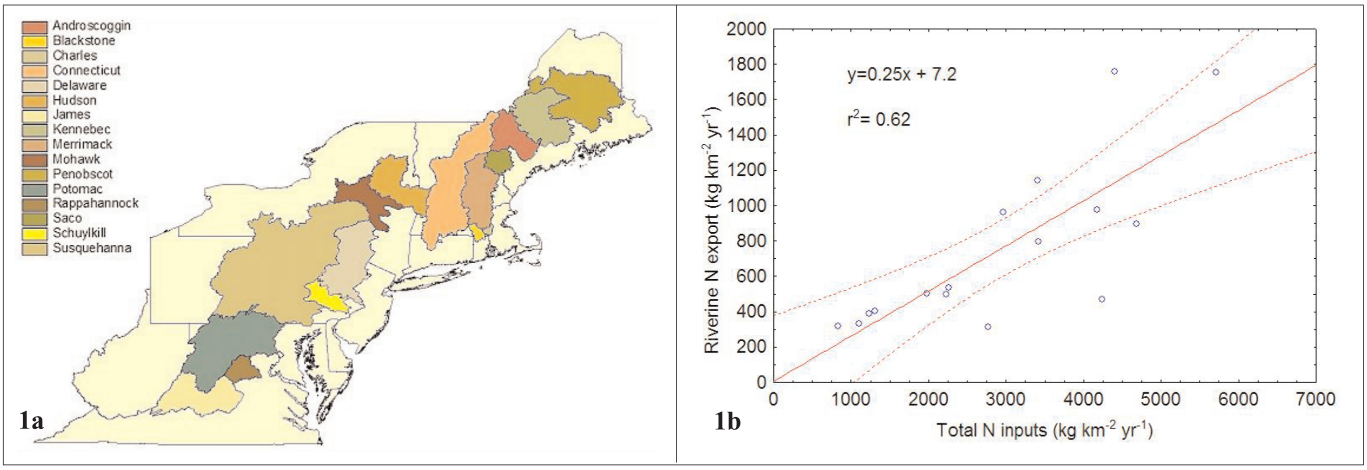

Figure 1a. ***Sixteen major watersheds of the Northeastern United States. In each case, boundaries are delimited by the furthest downstream USGS gauging station, and so do not include the portions in closest proximity to the coast. Figure 1b. Relationship between total N inputs to the watersheds (NANI) and riverine N fluxes from the watersheds (data from Boyer et al., 2002).***

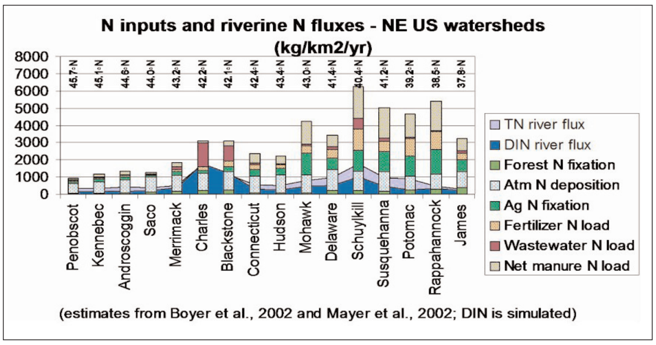

Figure 2. *Variation in major sources of N inputs (bars) and N fluxes in rivers (areas) to watersheds and corresponding outflows in rievrs for the northeastern US watersheds along a gradient from North to South. Latitudes of the watershed centers are shown along the top of the figure. (from Swaney et al, 2005)*

Human and environmental health consequences of nitrogen are addressed under NANC's second goal. For example, while synthetic nitrogen fertilizer has been an essential component of the green revolution and has contributed to increased global food production and decreased hunger and malnutrition over the past several decades, nitrogen can pose carcinogenic risks both from nitrate in drinking water and from fine particles in the atmosphere (Figure 3).

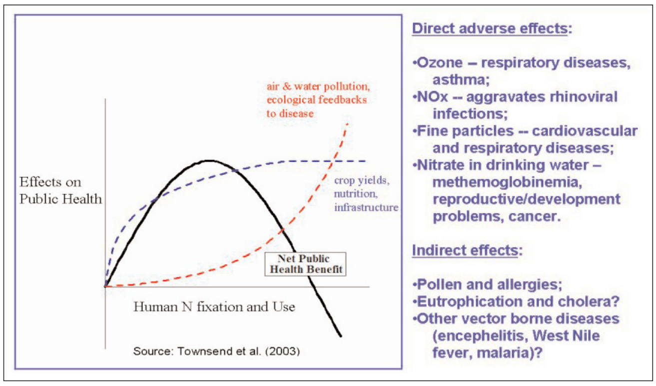

Figure 3. *The tradeoff between benefits and negative health effects associated with increasing levels of nitrogen use.*

Nitrogen pollution also increases pollen production, aggravating asthma and allergies (Townsend et al., 2003). Further acceleration of the nitrogen cycle can have large, net negative effects on public health.

Although there have been many attempts to quantify discrete portions of the region's nitrogen cycle in the past 30 years (including several LOICZ initiatives), a comprehensive assessment of N sources and health consequences of N pollution has not been previously attempted, and this is part of the second goal of the NANC.

Policy options are considered under NANC's third goal. These range from assessing the implications of agricultural Best Management Practices on coastal nitrogen loads, to assessing which components of NANI dominate local nitrogen sources, to understanding the implications of human accelerated climate change on nitrogen transport and processing in the environment. For example, in attempting to further understand the relationship between nitrogen inputs and outputs in watersheds, Howarth et al. (in press) suggested that hydrological controls (i.e., decreased residence times) can effectively short-circuit nitrogen retention in relatively "wet" watersheds (those with higher precipitation and streamflow), thus increasing the efficiency of transport of watershed nitrogen loads to the coastal zone (Figure 4a). This represents a potential mechanism by which changes in regional climate may be driving regional biogeochemical as well as hydrological fluxes (Figure 4b). Changes in land use patterns which increase runoff may exacerbate the problem. Policymakers should be considering the implications of these effects for the coastal zone in addition to the conventional list of expected impacts of climate change, such as sea level rise and increased hurricane frequency.

Finally, the importance of communicating research and policy implications to the scientific and management communities and the general public cannot be overemphasized, and this represents a key goal of the NANC, as well as LOICZ. This needs to occur on many levels, including advising government agencies on research and management priorities for the coastal zone and its watersheds, organizing workshops and hosting special sessions at scientific meetings, posting basic information, scientific summaries, workshop reports, and management tools on websites, and increasing public awareness via newsletters and informal presentations, such as this one. An example of its role as advisors to government policy, NANC staff were coauthors of the 2003 workshop report to the National Oceanic and Atmospheric Administration, "Nutrient Pollution in Coastal Waters: Priority Topics for an Integrated National Research Program for the United States"

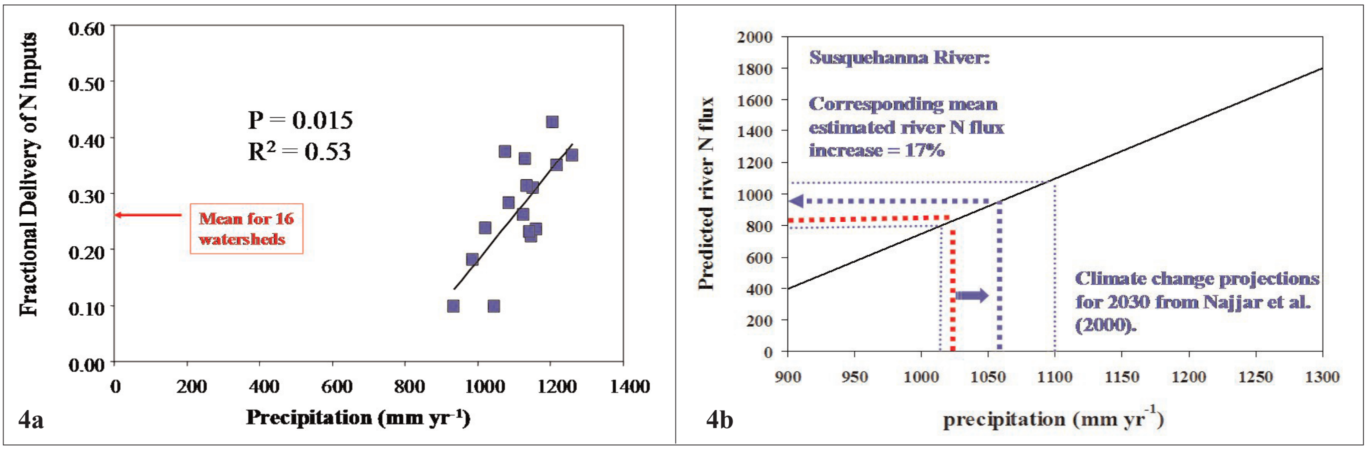

Figure 4a. *Observed relationship between average annual precipitation and fraction of watershed N inputs in riverine transport from the watershed for the 16 northeastern US watersheds studied (Howarth et al., in press).* ***Figure 4b.*** *Estimated increase in riverine nitrogen flux from current conditions (red line) to 2030 (blue line) corresponding to a regional climate change projection, assuming that the transport efficiency of nitrogen in the watershed increases with increasing wetness.*

(http://www.nccos.noaa.gov/documents/nutrientpollution.pdf). The Center will continue to be active at all of the levels mentioned above, and expect that interactions with LOICZ will enhance the productivity of both organizations.

LOICZ shares much that is outlined in the above goals, and has been active in all these areas to varying degrees; LOICZ II, has an emphasis on coastal governance and is concerned with policy and management options in the coastal zone. In the short term, LOICZ-NANC interactions are likely to include basic functions related to the last of the stated goals, including:

- Cross-posting activities (workshops, meetings, etc) on program websites and in newsletters
- Joint representation of program interests at scientific conferences, etc
- Sharing and web-hosting of relevant datasets and other materials
- Joint sponsorship or in-kind support of workshops, meetings, etc

Dennis Swaney currently serves as liaison between LOICZ and the NANC. To find out more see the NANC website (http://www.eeb.cornell.edu/biogeo/nanc/nanc.htm) and the website of its parent organization, the INI (http://initrogen.org). More specific inquiries about aspects of the NANC can be addressed by email to: nitrogen@cornell.edu.

References

Austin, A.T., R.W. Howarth, J.S. Baron, F.S. Chapin III, T.R. Christensen, E.A. Holland, M.V.. Ivanov, A.Y. Lein, L.A. Martinelli, J.M. Melillo and C. Shang . 2003. Human disruption of element interactions: drivers, consequences and trends for the 21st century. . Chapter 2, in SCOPE 61: Interactions of the Major Biogeochemical Cycles: Global Change and Human Impacts.. J. Melillo, C. Field, B. Moldan (eds.) Island Press, Washington.

Boyer, E.W., C. L. Goodale, N. A. Jaworski and R. W. Howarth. 2002. Anthropogenic nitrogen sources and relationships to riverine nitrogen export in the northeastern U.S.A. Biogeochemistry 57/58:137-169.

Howarth, R.W., R. Marino, and D. Scavia. 2003. Nutrient pollution in coastal waters: priority topics for an integrated National research program for the United States. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Silver Spring, MD.

Howarth, R.W., D.P. Swaney, E.W. Boyer, R.M. Marino, N. Jaworski and C.L. Goodale. In Press. The influence of climate on average nitrogen export from large watersheds in the Northeastern United States. Biogeochemistry.

Mayer, B., E.W. Boyer, C.L. Goodale, N.A. Jaworski, N. Van Breemen, R.W. Howarth, S.P. Seitzinger, G. Billen K. Lajtha, K.J. Nadelhoffer, D. Van Dam, L.J. Hetling, M. Nosal, and K. Paustian,. 2002. Sources of nitrate in rivers draining sixteen watersheds in the northeastern U.S.: Isotopic constraints. Biogeochemistry 57/58: 171–197.

Najjar, R. G., H. A. Walker, P. J. Anderson, E. J. Barron, R. J. Bord, J. R. Gibson, V. S. Kennedy, C. G. Knight, J. P. Megonigal, R. E. O'Connor, C. D. Polsky, N. P. Psuty, B. A. Richards, L. G. Soreson, E. M. Steele, and R. S. Swanson. 2000. The potential impacts of climate change on the mid-Atlantic coastal region. Climate Research 14: 219-233.

Swaney, D.P., R. W. Howarth, A.E. Galford, R.M. Marino and E.W. Boyer. 2005. Latitudinal and Temporal Changes in Discharge and Nitrogen Fluxes from Large Watersheds in the Northeastern United States: An Application of ReNuMa. Poster Presentation at the 18th Biennial Conference of the Estuarine Research Federation, Norfolk, VA. 17-21 October.

Townsend, A. R., R. W. Howarth , F. A. Bazzaz , M. S. Booth , C. C. Cleveland , S. K. Collinge , A. P. Dobson , P. R. Epstein, E. A. Holland , D. R. Keeney , M. A. Mallin , P. Wayne and A. Wolfe. 2003. Human health effects of a changing global nitrogen cycle. Frontiers in Ecology and the Environment 1(5):240-246.

Van Breemen, N., E.W. Boyer, C.L. Goodale, N.A. Jaworski, K. Paustian, S.P. Seitzinger, K. Lajtha, B. Mayer, D. Van Dam, R.W. Howarth, K.J. Nadelhoffer, M. Eve, and G. Billen. 2002. Where did all the nitrogen go? Fate of nitrogen inputs to large watersheds in the northeastern U.S.A. Biogeochemistry 57/58: 267–293.

4th GKSS Fall School on Helgoland

By Götz Flöser

GKSS-Forschungszentrum Institute for Coastal Research
Max-Planck-Straße 1, D-21502 Geesthacht, Germany
e-mail: goetz.floeser@gkss.de

On the island Helgoland in the North Sea, the Fourth GKSS School of Environmental Research which was endorsed by LOICZ, was held from 2nd-11th November, with some 20 participants. Among them were guests from Nigeria, Sri Lanka, India and Brazil. The School was initiated by Hans von Storch, a climate researcher from GKSS Research Centre in Geesthacht, Germany, and by Richard Tol, an economist from the University of Hamburg.

The theme for the School was "Environmental Crises – Science and Policy", a subject that connects natural science (as in climate research, fisheries, or chemistry) to social science, journalism, and economics. The example of the politically motivated introduction of lead-free gasoline in the 80s can show the response time of a natural system like the Elbe River catchment area. Another up-to-date subject where policy and science are intimately connected is climate research and climate policy. Apart from lectures, the participants developed presentations in the line of the IPCC position of climate change and on the side of "sceptical environmentalist" as represented by the Danish statistician Bjørn Lomborg. As had been the case in the first three Schools, a Springer book will be prepared with the contributions of the lecturers.

IPO NOTES

LOICZ Scientific Steering Committee as of January 2006

Newsletter 35 introduced Jozef Pacyna and Dennis Swaney who have now been confirmed as the new chair of the LOICZ SSC and the newest member of the SSC respectively. We look very much forward to working with them both in the future.

From 1 January 2006, the LOICZ SSC will have the following membership:

Name	Country	Some fields of interest
Talaue-McManus, Liana *Ex-Officio Past-chair*	USA/Philippines	Coastal systems ecology, river – coast coupling and Human Dimensions
Pacyna, Jozef - *Chair*	Norway	Trace gases, river-coast coupling, integration
Lansigan, Felino *Vice chair*	Philippines	Land and Water resources, statistics and Human Dimensions
Parslow, John	Australia	System Models and biogeochemistry
Dennison, William C.	USA	Coastal ecology, rivers, science dissemination
Forbes, Anthony	South Africa	Ecology, river-coast coupling
Huang, Wei-Gen	China	Remote Sensing and satellite oceanography
Koike, Isao	Japan	Biogechemical cycles and microbiology
Newton, Alice	Portugal	Lagoon ecology, scales and training
Rabalais, Nancy	USA	River-shelf coupling and estuarine ecology
Restrepo, Juan Dario	Colombia	River-coast coupling, sediments and hydrology
Saito, Yoshiki	Japan	Sediments and Deltas
Wikramanayake, Nalin	Sri Lanka	Hydrodynamics, sediments and water quality
Gilbert, Alison	Netherlands	Coastal and catchment management, decisions support systems and Human Dimensions
Roth, Eva	Denmark	Economy, fisheries and Human Dimensions
Glaeser, Bernhard	Germany	Coastal management, participation and Human Dimensions
Mee, Laurence	UK	Management, biogeochemistry and socio-ecological systems
Olsen, Stephen	USA	Coastal management, governance and participation
Swaney, Dennis	USA	Biogeochemical budgets, typology and river-coast coupling

A number of changes in the SSC will become effective from January 2006 as some members rotate off and we take this opportunity to thank those members for their contribution to LOICZ particularly during the transition of LOICZ to its second 10 year phase of research and synthesis, namely: Laura David (3 Years, Philippines); Elene Andreeva (2 years, Russia); Maria Snoussi (3 years, Morocco); Michel Meybeck (3 years, France); Peter Burbridge (6 years, UK) and Shu Gao (6 years, China).

Special mention goes to our outgoing Chair Liana Talaue-McManus who has been on the SSC for 7 years and for the past 2 years as Chair has been instrumental to the development of the new Science Plan and Implementation Strategy for LOICZ. Her guidance and diplomacy in handling an at times volatile and argumentative SSC, as is characteristic of a group of academics tasked and challenged to speak with one voice, has been critical and she leaves LOICZ well placed to continue making a significant contribution to coastal sciences and informing societal needs. We are glad that Liana will remain an Ex-Officio member of the LOICZ SSC as a Past-chair.

New office, new address and new contact details for LOICZ IPO and staff

As of **1 January 2006** the **LOICZ International Project Office** will be housed at the **Institute for Coastal Research at GKSS** in Geesthacht, Germany. The new office address and staff contact details are as follows:

LOICZ IPO
GKSS-Forschungszentrum
Institute for Coastal Research
Max-Planck-Straße 1
D-21502 Geesthacht
Germany

Phone: +49 4152/87-2009
Fax: +49 4152/87-2040
E-mail: loicz.ipo@loicz.org
Web-site: www.loicz.org

NEW e-mail addresses of current IPO staff:

Hartwig H. Kremer	- hartwig.kremer@loicz.org
Martin Le Tissier	- martin.letissier@loicz.org
Hester Whyte	- hester.whyte@loicz.org
Maike Paul	- maike.paul@loicz.org

Important note: Because of the holidays and the IPO moving we will be **closed from 23 December 2005** and **re-open** at the new location in Germany **on 16 January 2006**.

PUBLICATIONS

*Keep an eye on the LOICZ website for news on **new LOICZ R&S reports** that will soon be available as hard copy and electronic download.*

SEPM Special Publication #83: River Deltas-Concepts, Models and Examples.
Edited by Liviu Giosan and Janok Bhattacharya. Order online: www.sepm.org/SF6/detail.aspx?ID=115.
Table of content: www.sepm.org/publishing/toc/sp83toc.htm

HAVE YOU SEEN

Delta Competition for students- The DeltaCompetition is organised by Royal Haskoning in the context of its 125th anniversary next year. The DeltaCompetition aims to come up with innovative, creative, sustainable solutions to typical delta area problems related to climate change, sea level rise, increased river discharges, etc. We are in particular looking for multi-discipline solutions and therefore invite teams of students to register and submit scientific papers, presenting their solution. www.deltacompetition.nl

MEETINGS & WORKSHOPS

For a complete list of future meetings and regular updates visit our web-site at www.loicz.org

19 January 2006, The Hague, The Netherlands: RIKZ' CoastNet Conference – Participatory planning and working with natural processes on the coast. Contact Pat Stitt at pat@coastnet.org.uk

2-7 April 2006, Vienna, Austria: a special sessions on **Coastal Biogeochemistry** during the General Assembly of the European Geosciences Union. Session is co-sponsored by LOICZ and CARBOOCEAN and listed as session BG3.01. http://meetings.copernicus.org/egu2006/

17-21 July 2006, Espoo, Finland: Living with Climate Variability and Change-Understanding the Uncertainties and Managing Risks. www.livingwithclimate.fi

4-8 September 2006, Mexico City, Mexico: Carbon Management at Urban and Regional Levels: Connecting Development Decisions to Global Issues.
www.globalcarbonproject.org/meetings/2006/Carbon Management UnrbanConferenceMexicoSept06.pdf

7-8 November 2006, Beijing, China: 2nd International Young Scientists' Global Change Conference.
e-mail: ysc@agu.org or visit www.start.org

23-27 January 2007, Chiang Mai, Thailand: International Dialogue on Science and Practice in Sustainable Development: Linking knowledge with action. www.sustdialogue.org.
Deadline for submission of proposals **1 February 2006**

Special thanks

On behalf of the entire LOICZ community (SSC, Regional Nodes, LOICZ Scientists and the IPO) we wish to thank everyone at our hosting institute Royal NIOZ, collaborating organizations and institutes and everyone we worked with in the Dutch Science community and the Dutch funding agencies for their support, contribution, input and dedication for the LOICZ project. We hope that although the International Project Office will now move to a new location at GKSS in Germany, that our ties with the Netherlands will remain fruitful and we look forward to continued collaboration in an even more challenging field of Global Change Science.

For address or subscription changes please contact the LOICZ IPO by regular or e-mail indicating you wish to receive the newsletter:

A. by an e-mail alert when it is posted on the LOICZ website
B. by receiving an e-mail with the newsletter as PDF file attached
C. by hard copy
D. Unsubscribe

IPO STAFF

Hartwig Kremer
Executive Officer

Martin Le Tissier
Deputy Executive Officer

Hester Whyte
Office Manager

Maike Paul
Intern

New address from 1 January 2006

LOICZ International Project Office
GKSS-Forschungszentrum
Institute for Coastal Research
Max-Planck-Straße 1
D-21502 Geesthacht
Germany

Phone: +49 4152/87-2009
Fax: +49 4152/87-2040
E-mail: loicz.ipo@loicz.org

www.loicz.org