

LOICZ NEWSLETTER

Understanding the biocatalytic sand filter in the shelf

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In coastal and shelf environments strong bottom flows, lateral sediment transport, an abundant benthic fauna and strong seasonal variations cause high variability in the biogeochemical cycles and turn the investigation of this important zone into a challenging task. A major focus of the current LOICZ program is the cycling of matter in the coastal zone with emphasis on the fate of organic carbon, and this theme will be extended in the new LOICZ program. Key issues within this research framework will be the processing of materials while transported across the shelf and the contributions of these materials to the oceanic cycles of matter. Due to the intense coupling of water column and sedimentary processes in the shelf, the seabed plays a central role in the transformation of matter in the coastal oceans. In this contribution, we highlight the potential importance of sandy shelf beds for the cycling of matter in the coastal zone. Our relatively poor understanding of these sedimentary systems calls for a joint effort in this interesting field of research.

More than 50% of the continental shelves are covered by sandy sediments and these sea beds are of significant socio-economic value: they support the most productive fishing grounds and are important sources for a variety of raw materials (oil, gas, water, minerals). From their work in



This is the twenty fifth newsletter of the Land Ocean Interactions in the Coastal Zone (LOICZ) International Project of the IGBP. It is produced quarterly to provide news and information regarding LOICZ activities

the SEEP-I area, Rowe *et al.* (1988) reported the highest benthic biomass and the highest relative importance of

macrofauna in the shallowest, sandiest sediments, which may explain the high abundance of fish. Despite their ecological and economic importance, permeable shelf sands have been poorly studied with respect to their role in the coastal cycles of matter partly owing to the misconception that a sediment that is poor in organic matter cannot contribute significantly to organic matter, nutrient and contaminant cycles. Recent studies, however, indicate that sandy ecosystems may be very efficient in the transformation of organic compounds (Bacon *et al.* 1994, Shum and Sundby 1996) and underline the necessity of a concerted effort in investigating this important coastal system.

The composition and structure of the sediments in the coastal zone are controlled by the input of particulate matter from land and ocean, currents and waves, and by benthic biological and geochemical processes (*Figure 1*).

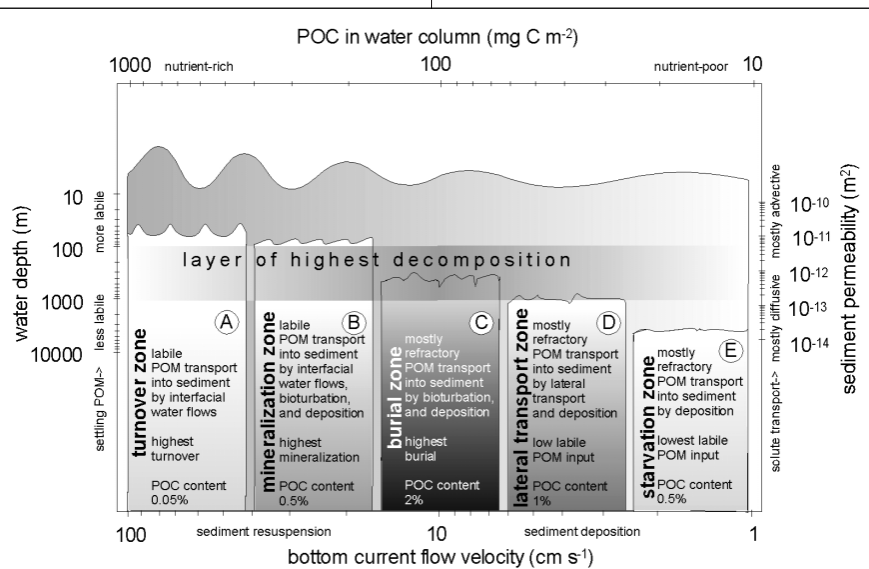


Figure 1. The relative contribution of sediment to the cycle of organic matter and the dominant transport mechanisms for the exchange of matter between sediment and overlying water column (from Huettel and Rusch 2000).

With decreasing distance from land, nutrient concentrations in the water column increase, fueling intense primary production and associated pelagic life. The decreasing water depth boosts the impact of currents and waves on the sedimentary environment. Where the water is shallower than approximately half the wave length of the surface gravity waves, oscillating flows are generated at the sea floor, bed ripples form and the upper sediment layer is eroded and resuspended during storm events. Likewise, tidal oscillations enhance bottom currents and further increase the hydrodynamic forcing acting on the shelf beds. Mineral inputs from land and frequent sediment resuspension and winnowing produce permeable shelf sediments with relatively coarse grain size and low organic content (Huettel and Rusch 2000).

The sedimentological characteristics of the shelf beds reveal important clues about the mechanisms and intensity of the exchange of matter between water column and sediment. The intense bottom currents in near-shore regions easily resuspend deposited low-density materials, preventing accumulation of organic matter at the sea floor. This observation may suggest that sandy beds in high-energy nearshore regions cannot accumulate organic matter. However, where sediment permeability exceeds 10^{-12} m^2 , advective transport processes gain importance for the transfer of solutes and particles into and out of the sediments, providing a pathway for organic matter into the bed. Wave pumping, the pore water exchange due to surface wave-induced hydrostatic pressure oscillations at the sea floor, filters on average $33 \text{ l m}^{-2} \text{ d}^{-1}$ through shallow sandy shelf sediments (Riedl *et al.* 1972). The filtration rate produced by the interaction of boundary flows with small sea-bed topography can be one order of magnitude larger (Webb and Theodor 1968). Here, boundary flows driven by wind, tides and waves are deflected by protruding and recessed sediment surface structures, generating lateral pressure gradients that force fluid into the permeable bed and draw pore water out of the sediment. Each sedi-

ment ripple is associated with a pore-water flow field with intrusion zones in the ripple troughs and upwelling zones under the ripple crests (**Figure 2**).

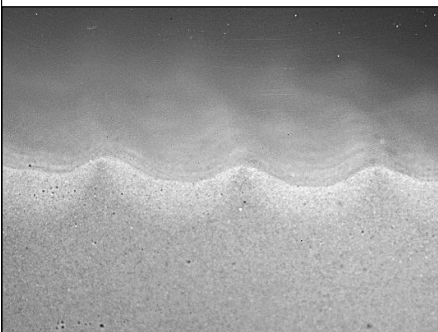


Figure 2. Pore-water exchange at sediment ripples due to wave-generated flow oscillations.

In shelf beds with the common grain size spectrum of 200-500 μm , this advective pore-water exchange represents an effective mechanism for organic matter transport into the bed. Investigations of excess ^{210}Pb in the Middle Atlantic Bight Continental Shelf sediment indicate that fine particulate matter must undergo several cycles of burial and resuspension during its transit across the shelf, revealing the intense coupling between sedimentary and water column processes (Bacon *et al.* 1994). Flume and *in-situ* experiments have demonstrated that planktonic algae are carried several centimeters into sandy sediment within a few hours, where they accumulate at a specific depth dependent on their size, stickiness and strength of pore-water flow (Huettel and Rusch 2000; Pilditch *et al.* 1998). Larger aggregations of organic matter that can accumulate in ripple troughs are buried temporarily by migrating ripples (Jenness and Duineveld 1985) or by abundant benthic fauna (Ziebis *et al.* 1996). Percolated by intruding oxygen-rich water, these organic matter accumulations are rapidly degraded. Removal of the decomposition products with the advective flows enhances mineralization and releases the products of this process, the nutrients, to the water column. Oxygen consumption in sandy sediments of the northeastern US shelf reaches comparable values to that of the fine-grained organic-rich deposits from nearby locations in the

shelf (Rowe *et al.* 1988). On the eastern North Pacific continental margin similar results have been reported (Archer and Devol 1992, Devol and Christensen 1993).

In their study of mineralization processes in sandy sediments of the South Atlantic Bight Continental Shelf, Marinelli *et al.* (1998) found mineralization rates that suggest a residence time of particulate organic nitrogen in the upper 12 cm of the sediment column of only 6 years. With ammonium production rates similar to those in fine grained near-shore sediments, these results suggest that the low content of particulate organic nitrogen is due to rapid nitrogen cycling in these sediments. Despite this intensive degradation process, advective pore water exchange keeps the nutrient concentrations in these sediments low. However, the high benthic primary production despite low nutrient concentrations in the water column indicates that the sediments are an important source of nutrients. At the study sites in the South Atlantic Bight Continental Shelf visited by Jahnke *et al.* (2000) between May and September 1996, benthic microalgal gross primary production averaged $400 \pm 260 \text{ mg C m}^{-2} \text{ d}^{-1}$ while water column primary productivity averaged $682 \pm 176 \text{ mg C m}^{-2} \text{ d}^{-1}$ demonstrating the importance of the sandy beds for nutrient regeneration and the organic matter cycles in the shelf.

Analogous to the transfer of oxygen or planktonic algae into sandy sediment, dissolved and suspended contaminants are carried into permeable shelf beds with the advective pore-water flows. The ^{210}Pb that is transported into the sediments reveals how these permeable beds can extract contaminants from the water column and demonstrates the importance of sorption in the coarse grained sands. Study of the sandy Middle Atlantic Bight Continental Shelf sediment showed that more than half of the total ^{210}Pb inventory was contained in the coarse fraction of the sediment and could be removed by repeated sonification (Bacon *et al.* 1994). This ^{210}Pb that initially was transported into the

sediment adhering to organic particles, thus was subsequently adsorbed by coatings on the sand grains when the organic matter was mineralized. A similar behavior can be expected for heavy metals or organic contaminants.

However, the assumption that the adsorbed substances are removed from the cycles of matter in the shelf is misleading. The fluid that is drawn from deeper sediment layers to the surface by the reduced pressure associated with protruding sea bed topography can generate vertical anoxic channels that link the deeper, anoxic sediment layers to the water column (*Figure 3*).

In flume experiments dissolved ferrous iron was carried within such an anoxic channel through 10 cm of oxic sediment and released to the water column (Huettel *et al.* 1998). Ferric iron precipitation and iron oxidizing bacteria, growing where the pore-water emerged exemplifies this upwelling process. The same mechanism can release heavy metals from deeper sediment layers within short time periods if suitable flow and topography are present, and the anoxic pore fluid ascending through oxic layers can leach precipitated substances from the sediment.

consequence of these increases, numerous ecological niches for bottom-dwelling organisms are generated, which in a feedback loop further enhances the spatial and temporal heterogeneity of the shallow sediment environment.

Our perception of benthic environments and their metabolic functions is dominated by the concept of deep water fine grained sediments that display a horizontal lamination of biogeochemical zones that, although perturbed by the occasional bottom dweller, does not change significantly over time and space. This conservative view is reflected in the paucity of methods suitable for the investigation of dynamic coastal sediments. With very few exceptions, sediment samplers or coring devices are not suitable for non-cohesive sediments because they cannot seal and stabilize the sampled core and the ensuing mixing and (partial) loss of pore water can fundamentally change the biogeochemical zonation of in the retrieved sediment. Likewise, the removal of permeable sediment from its flow environment immediately changes its geochemical characteristics, making subsequent measurements in isolated cores highly questionable. Although bottom currents and permeability are crucial factors determining the transport and reaction in coastal sediments, hardly any publication addressing processes in shelf beds contains information regarding these important parameters. The magnitude of spatial heterogeneity in coastal deposits may match the magnitude of the temporal variability requiring revised sample dimensions and sampling strategies. One-dimensional modeling approaches assuming diffusion to be the only significant transport mechanism are unanimously applied for the estimation of geochemical reaction rates, fluxes and diagenetic processes in all marine sediments, although these models may not be suitable for shelf beds with increased sediment permeability.

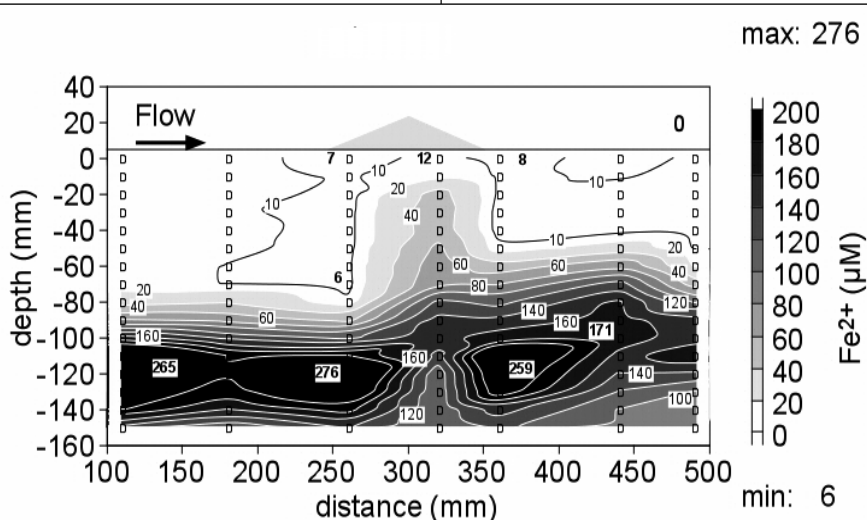


Figure 3. Upper graph: Transport of ferrous iron to the sediment surface with upwelling pore water in a flume. The sediment was sand with median grain size of 350 μm , flow was 10 cm s^{-1} at 8 cm above the sediment surface.

Lower graph: Small mounds on a sediment exposed to unidirectional flow in a flume. Ferric iron precipitated where pore water rich in ferrous iron is released from the sediment. (modified from Huettel *et al.* 1998)

When ripple topography starts moving under strong surface waves or bottom currents, the associated pore-water upwelling zones move accordingly and a mechanism is initiated that subjects the upper sediment layer to a moving pattern of up- and down-welling zones. In extreme cases, each location within this layer experiences redox states oscillating between fully oxic and fully anoxic conditions with a frequency dictated by the ripple movement, a scenario most effective for stimulation of microbial activity and mobilization of sorbed substances (Aller 1994).

Thus, with decreasing distance from the coast, the sedimentary biogeochemical processes not only become more intense but also their spatial and temporal complexity increases dramatically. As a

After a critical look at our present knowledge of the contribution of the shallow shelf to the oceanic cycles of



matter, we may have to admit that this biogeochemically most active, most diverse and most endangered environment on our coasts is the one least understood. International initiatives such as LOICZ, the SCOR Group 114 "Transport and Reaction in Permeable Sediments" and the Gordon Research Conference 2003 on "Permeable Sediments" work towards a better insight into shallow coastal zone processes.

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The Future of LOICZ – Status and Perspectives

While the Synthesis of the first period of LOICZ is continuing increasing efforts have been undertaken to start shaping the future LOICZ. In its transition phase LOICZ is expected to undergo considerable change in structure, operations, scientific objectives and scope of the project. This challenging process needs to rely on a solid funding base for both, operations and the science.

a) Support and operational structure

While considerable funding provided on a project basis sustains various large and medium size activities through and into LOICZ Phase II, the SSC and IPO have intensified their efforts to generate the necessary operational funding.

Following the recent recommendations of the international evaluation of the LOICZ IPO, the Dutch funding agencies and our hosting institution (Royal NIOZ) are investigating options to keep the IPO executive node in the Netherlands for another three years. The generous support from the Netherlands in the past has allowed LOICZ to successfully fulfil its global commitments and continued support will allow the IPO to sustain the LOICZ transition into the new phase.

In parallel – and building on the experience of Phase I, which showed the necessity for an operational focus at regional scales - the IPO has intensified its efforts to identify and establish “**Thematic/Regional IPO Research Nodes**”. The objective of this distributed IPO model is to improve the networks and visibility of LOICZ research regionally, and to broaden the operational base by better accessing regional funding mechanisms. The distributed IPO in total will maintain responsibilities comparable to the present “single office” situation.

The regional nodes through their active participation in a distributed LOICZ IPO, will access the global framework and thinking of the LOICZ science network and provide a platform for global synthesis of thematic issues by regional experts into the global LOICZ work, supported by external funding. This interface will enable regional scientists to better engage with the global scientific and user community. It is anticipated that the nodes will establish and maintain networks of excellence in a particular field or fields of the future LOICZ research interests as endorsed by the LOICZ SSC.

Currently successful talks have taken place in Singapore (with the Division of Environmental & Water Resource Engineering, the Environmental Engineering Research Centre, Nanyang Technological University), in Australia (with the Cooperative Research Centre for Coastal Zone, Estuaries and Waterways Management and several Queensland state agencies), and Germany (with the GKSS Research Centre, Geesthacht). A draft TOR has been exchanged and letters of agreement are under development, tailored to the individual needs of the potential nodes. Generally, the funding basis for node operations has been agreed on in-principle and options for implementation are being developed. Singapore is expected to be the first IPO node starting operations. Potential for further IPO nodes is currently being discussed with China and Brazil.

b) Science planning and sponsorship

LOICZ IPO has intensified its contacts with the IHDP with a view to establishing a close affiliation between LOICZ II and IHDP as well as with IGBP. A joint working group of IHDP- and LOICZ SSC representatives is being established to develop the new LOICZ Science Plan; each IHDP core project and the recently launched urbanization task team will be represented in the working group. We expect the working group to hold a first scoping meeting in early 2003. The Science Plan will be founded on the five main thematic areas identified over the last 18 months through workshops, the May 2002 Miami Conference and wide ranging discussion documents. The joint working group will consider the thematic areas and develop the “traditional” natural and the “new” human dimensions oriented sciences and links.

LOICZ is looking forward to this close operational engagement with IHDP, which is expected to generate an appropriate integration of socio-economic research into the future LOICZ contribution to the collaborative Earth System Science Program (ESSP) of IGBP, IHDP, WCRP and

DIVERSITAS. The IGBP-SC will discuss LOICZ II developments in January 2003 and the IHDP-SC (are) expected to consider the LOICZ co-sponsoring issue in March 2003.

Successful steps have also been made towards a broadening of the sponsoring base for scientific assessment and synthesis. LOICZ was invited to present its future directions to the recent SCOR General Meeting held in Sapporo, Japan, in early October 2002. The potential for a co-sponsoring role of SCOR supporting the new LOICZ implementation was discussed and there was in-principle agreement towards a new level of links with LOICZ. Both organizations look back on a successful co-operation by specialist working groups, e.g., on coral adaptation to climate change and on submarine groundwater discharge. While not all aspects of the new LOICZ science thematic areas are of core interest to SCOR, it was recognized that the broad interdisciplinary focus of LOICZ, encompassing the continental shelf, would complement the scientific priorities of SCOR. Comparable sponsorship arrangements being discussed with UNESCO/IOC.

“Source to Sea” Coast to Coast 2002, Australia’s National Coastal Conference

Coastal Management and the complex role of science, institutional issues and participation under scenarios of increasing demographic and climate change pressures were addressed in the Coast to Coast conference hosted by the states of New South Wales and Queensland in Tweed Heads, Australia, 4-8 Nov. 2002. With a view on federal and state levels a status review was provided and perspectives of change – response options were investigated extensively. While in the global context Australia’s coastal issues seem to be less concerning, on local scales growing concern is driven particularly by increasing tourism and

climate change affects expected to impact the coastal zone. Public participation and involvement has generated a sound basis and considerable ownership of issues for integrated management in Australia different than in most other places of the world. However, the often missing link between the catchments and their land based issues with coastal seas as a single water cascade system needs growing attention. For more details of the contributions and outcomes a summary and reports of the thematic working group discussions are available through the following links: <http://www.coastal.crc.org.au/coast2coast2002/orderproceedings.pdf> and <http://www.coastal.crc.org.au/coast2coast2002/proceedings.html#conclusions>

LOICZ IPO NOTES

Newsletter review and Communications – We need your input!

LOICZ would like to improve our level of information transfer and science dissemination, as part of a broader communication strategy in our new strategic plan. We would like to provide information through tailored media interfaces to a variety of target groups. Those groups include: the internal LOICZ community, the wider scientific world, and the public and science users. In a first step, we want to evaluate the utility and effectiveness of our current LOICZ newsletter. We ask your help **by completion of the attached questionnaire and returning it to us no later than the 23rd of January 2003**. This will allow us to improve our current product to better match your needs and expectations and thus serving the internal and external information flow and visibility of LOICZ. We count on your support and look forward to your invaluable information.

Chris Crossland anchors at the Sunshine Coast.

The LOICZ IPO and SSC and all the people who have worked with Chris would like to wish him and his family a shining future back in Australia. It has been a pleasure and a matter of

constructive intercultural and practical learning, working with Chris and later also Jan in the IPO. Chris as a person and an expert was a rich experience for all of us and an invaluable generator of momentum for LOICZ. LOICZ is now heading into a future featuring new challenges, new tracks to follow, gaps to bridge and quite a bit of uncertainty to deal with and we look forward to keep close contacts with Chris.

We plan to ensure that the LOICZ project continues to provide the sound scientific information and models "to tell Chris in time when he needs to leave his home at the beach and climb Mount Coolum to escape whatever nasty events Global Change has prepared for us "Coastal dwellers" as a revenge for our efforts to uncover its secrets..."

All the best.

Hartwig, Hester & Mildred

In memoriam Wim van Raaphorst

On Wednesday 6 November 2002 Dr Wim van Raaphorst of the Royal Netherlands Institute of Sea Research was hit by a car while cycling home on his beloved island of Texel and died later that evening. Wim van Raaphorst was head of the department of Marine Chemistry and Geology at NIOZ and has been a supporter of LOICZ-related research in the Netherlands since many years. He served on the LOICZ committee of the Royal Netherlands Academy of Arts and Sciences when it was in the transition between planning and executing the science. Furthermore he was a member of the steering committee for the Flemish-Dutch cooperation programme in Estuarine and Coastal Research, which also sponsors LOICZ-related research. In this capacity, Wim has exerted an important influence in shaping these programmes and in the selection of the projects and his wisdom and objectivity were widely appreciated by his colleagues in these committees. He also had a major role in developing the cooperation between Royal NIOZ and the Netherlands Institute of Ecology, which also got much

of its inspiration from LOICZ, and he could do so because he was trusted and appreciated by all involved. As a colleague and as a friend he will be missed by all of us in the Dutch marine science community and beyond.

Carlo Heip, Centre for Estuarine and Marine Ecology, Chair of the former Netherlands LOICZ Committee and Chair of the Flemish-Dutch Cooperation Programme in Estuarine and Coastal Science also on behalf of the LOICZ IPO and Chair

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Global Terrestrial Observing System: LocClim CD-ROM v1.0, the FAO Local Climate Estimator. LocClim provides estimates of climatic conditions at locations for which no observations are available.

Visit: http://www.fao.or/sd/2001/EN1102_en.htm and

http://www.fao.org/gtos/tems/tsite_list.jsp. For free copy of CD-ROM v1.0, please send your request to gtos@fao.org & provide your full mailing address.

WHAT'S ON THE WWWEB

Web-sites on Biogeochemical Budgets and Modelling, Typology, Basins, Deltas Management & South-Asia Coastal Fluxes are accessible via the LOICZ home page:

<http://www.nioz.nl/loicz>

GOOS Newsflashes:

<http://ioc.unesco.org/goos/GOOSnews/flashes.htm>

Launching of Indian Ocean GOOS (IOGOOS) at the IOGOOS Conference in Grand Bay Mauritius. For more info visit:

<http://ioc.unesco.org/iode/contents.php?id=110>

Remote Sensing Handbook for Tropical Coastal Management (extracts) at:

<http://www.unesco.org/csi/pub/source/rs.htm>

Report of the International Future Search Conference: <http://www.rabbitgraph.de/inwent>

LOICZ PUBLICATIONS

Available as printed copies and also downloadable from the LOICZ website. For hard copies of LOICZ R&S volumes (as long as stocks last), e-mail: mildred@nioz.nl.

Caribbean Basins: LOICZ Global Assessment and Synthesis of River Catchment/Island-Coastal Sea Interaction and Human Dimensions; with a desktop study of Oceania Basins. Eds. Kjerfve, B., W.J. Wiebe, H.H. Kremer, W. Salomons and J.I. Marshall Crossland (Caribbean); N. Morcom, N. Harvey and J.I. Marshall Crossland (Oceania). 2002, *LOICZ Reports & Studies No.27*, ii + 174 pages, LOICZ IPO, Texel, The Netherlands.

OTHER PUBLICATIONS

Special Issue: Regimes of Regional and Global Coastal Change. A selection of papers from the 4th LOICZ Open Science Meeting, Bahia Blanca, Argentina, November 1999; Eds.: Kremer, H., Pacyna, J. and N. Pirrone; in: *Regional Environmental Change* Vol. 3, No. 1-3, 117 pages; Springer, Berlin, Heidelberg New York (order and inquires to: journal@springer-ny.com)

Climate Of The 21st Century: Changes and Risks, 448 pages, 2001, Germany. Eds: J.Loazan, H. Grassl, P. Hupfer.

For more information & to order visit: <http://www.rrz.uni-hamburg.de/Klima2000> or e-mail:

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Price: € 30,- + € 5,- for postage and handling. **LOICZ Newsletter readers get a discount of 30%.**

Coasts: Form, Process and Evolution, by Colin D. Woodroffe, 2002, 616 pages, Cambridge University Press, Australia.

For more info and ordering pre-publication please send request to: Cambridge University Press-Australian Branch, 477 Williamstown Rd (Private Bag 31), Port Melbourne, Victoria 3201, Australia. Phone: +61 (0)3 86711400, fax: +61 (0)3 96769955 or e-mail: info@cambridge.edu.au (PB 2 A\$ 89.95, HB @ A\$ 265 incl. GST)

Coastal Management in Australia, by Nick Harvey and Brian Caton, available soon, 352 pages, Oxford University Press, Australia. For more info & ordering send request to GPO Box 2784Y, Melbourne, Victoria 3001, Australia. Phone: 1300 650616, fax: +61-(0)3 99349100 or e-mail: cs@oup.com.au, free fax: 1800 813 602. Web-site: www.oup.com.au (PB A\$ 35.95 incl. GST)

Arctic Social Sciences: Opportunities in Arctic Research, published by the Arctic Research Consortium of the United States (ARCUS) for the National Science Foundation Arctic Social Sciences Program, is now available electronic at: http://www.arcus.org/ASSP/fr_download.html and in printed form from ARCUS, 600 University Avenue, Suite 1, Fairbanks, AK 99709, USA, phone: +1 907 474 1600, fax: +1 907 474 1604, e-mail: arcus@arcus.org

New publications of the Supervising Scientist Division (Environment Australia) are available at: www.ea.gov.au/ssd/publications. For information about the Supervising Scientist Division visit: www.ea.gov.au/ssd/index.

Among a variety of environmental issues those dealing with climate change affecting erosion processes and hydrology, wetland ecology and conservation are of specific interest (Report 165 and 166).

Executive summary online

<http://www.ea.gov.au/ssd/publications/ssr/165.html>

Executive summary online

<http://www.ea.gov.au/ssd/publications/ssr/166.html>

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CQD Journal for the Maritime Environment Industry Volume 8.4 is now on-line. Reports include updates from the Marine Environmental Protection Committee meeting in October. Treatment of ballast water for invasive species, recycling of ships, and greenhouse gas emissions provisions are highlighted. In addition, this Volume #8.4 includes comments regarding shipper's concerns about new maritime security measures and the curtailment of merchant shipper's access to certain ports. Go to: http://www.cqdjournal.com/CQD_Table_Contents/env_8_4/env_8_4.htm

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URL's for Springer LINK site on Regional Environmental Change:

General info: <http://link.springer.de/link/service/journals/10113/index.htm>
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LOICZ/IGBP/IHDP CALENDAR

For the latest meeting updates go to <http://www.nioz.nl/loicz> and click on 'Calendar'

European Conference on Coastal Zone Research: an ELOISE Approach, 24-27 March 2003, Gdansk, Poland. Information and instructions for abstract preparations visit:

<http://www.nilu.no/project/eloise/>

Deadline for abstracts: 15 January 2003

EGS/AGU/EUG Joint Assembly, 6-11 April 2003, Nice, France. Visit: <http://www.copernicus.org/egsa-gueug/index.html>. Special attention to session: "BG1.06: Coastal biogeochemistry and its response to anthropogenic perturbations: inputs, gas exchange and nutrients" For the full list of proposed sessions visit: <http://www.copernicus.org/EGS/egsa/nice03/programme/overview.htm>
Deadline for abstracts: 15 January 2003.

Open Meeting of the Human Dimensions of Global Environmental Change Research Community, 16-18 October 2003, Montreal, Canada.

For information visit:

<http://sedac.ciesin.columbia.edu/openmeeting>. Deadline for submissions: 30 March 2003

OTHER MEETINGS

Abrupt Climate Change Discussion Meeting 4 & 5 February 2003 at the Royal Society, London, United Kingdom. For information and registration visit: www.royalsoc.ac.uk/events

The Georgia Basin/Puget Sound Research Conference 31 March-3 April 2003, Westin Bayshore Hotel, Vancouver, Canada.

For more information visit:

http://www.wa.gov/puget_sound/Publications/2003research/RC2003_abstracts.htm

For more information on the Georgia Basin Ecosystem Initiative, visit:

http://www.pyr.ec.gc.ca/GeorgiaBasin/gbi_eIndex.htm

Oceans III Millennium: Second International Congress on Marine Science and Technology, April 2003, on the campus of the Universidad de Alicante, Spain. Please consult the conference web-site and give your opinion at: www.fomar.org

Final International JGOFS Open Science Conference "A Sea of Change: JGOFS Accomplishments and the Future of Ocean Biogeochemistry", 5-8 May, 2003, Washington DC, visit:

<http://usjgofs.whoi.edu/osc2003.html>

Deadline for early registration & submission of poster abstracts: 15 January 2003.

Rights and Duties in the Coastal Zone. Multidisciplinary Scientific Conference on Sustainable Coastal Zone Management. 12-14 June 2003, Stockholm, Sweden.

For more information visit: www.beijer.kva.se/conference.htm.
Deadline for abstract: 15 January 2003

The Chinese Academy of Science, Institute of Geographical Science and natural Resources Research & The Xishuangbanna Tropical Botanical Gardens and The Millenium Ecosystem Assessment 's International Conference : Bridging Scales and Epistemologies:

Linking Local Knowledge with Global Science in Multi-Scale Assessments, 23-26 June 2003, Kunming, China. Call for Proposals, deadline 20 December 2002.

For more information please contact Carolina Katz Reid, e-mail: conference@milleniumassessment.org or visit: <http://www.milleniumassessment.org>

Sixth Regional Symposium PACON 2003: Ocean Capital Year. 29 June-2 July 2003, Kaohsiung, Taiwan.

For information & submission of abstract visit:

<http://www.hawaii.edu/pacon>.
Deadline for abstract: 15 January 2003.

7th International Conference on Coelenterate Biology-ICCB7, 6-11 July 2003, at the University of Kansas, Lawrence, Kansas, USA.

For information visit: www.nhm.ukans.edu/inverts/iccb

The Impact of Global Environmental Problems on Continental & Coastal Marine Waters, 16-18 July 2003, Geneva, Switzerland. Visit: www.unige.ch/sciences/near

3rd IAHR Symposium on River, Coastal and Estuarine Morphodynamics, 1-5 September 2003, Barcelona, Spain. Call for papers and description of this Symposium visit: <http://www-ehma.upc.es/rcem2003/index.htm> Deadline for submission: 15 February 2003

International Conference on Remediation of Contaminated Sediments, 30 September- 3 October 2003, Venice, Italy. For information, registration and abstract submission visit: www.battelle.org/sedimentscon Deadline for abstracts: 10 January 2003.

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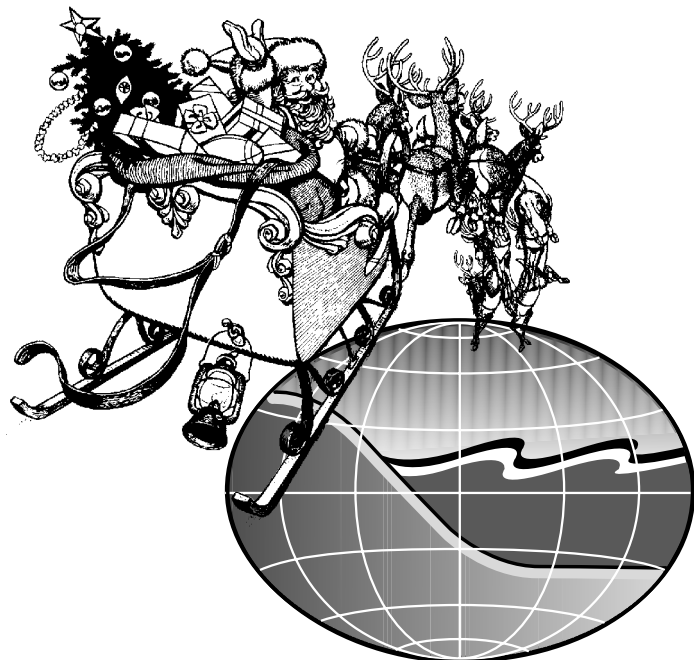
JAN CROSSLAND
Editor

*The LOICZ IPO staff
would like to wish everyone
a Merry Christmas*

&

all the best in the New Year.

*We look forward to your future collaboration
towards the new LOICZ.*



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