LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE

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LOICZ NEWSLETTER

Land Ocean Interaction in Africa - the current status of the LOICZ regional assessment and synthesis

Following from the Pan African Conference on Sustainable Integrated Coastal Management (PACSICOM) in July 1998 and the START/IOC/LOICZ Workshop on Climate Change and Coastal Processes in West Africa in November 1998, a key objective for LOICZ was to add a regional African overview to its global synthesis of coastal change and human dimensions under natural and anthropogenic pressure. This covers two aspects of coastal change: the coastal change itself, as determined by biogeochemical indicators, and the land-based drivers of coastal change, within the river basins.

As part of the UNEP/GEF-supported project *The Role of the Coastal Ocean in the Disturbed and Undisturbed Nutrient and Carbon Cycles*, LOICZ has been actively involved in a variety of assessment and synthesis efforts in Africa since 1998. These have provided models and budgets in estuarine and coastal seas of carbon, nitrogen and phosphorus fluxes and net system metabolism, developed by an expanding group of regional experts. A common methodology (LOICZ Reports and Studies Volume 5) was applied to assist with comparison between sites as local to global scales. Results are published in LOICZ Reports & Studies Volumes 18, 19 and 20 (see www.nioz.nl/loicz/fordownload) and the sites are shown in Figure 1:

Egypt
- Nile River delta: Rosetta Branch and Edku Lagoon (20)

Morocco
- Moulay Bousselham Lagoon (19)

Ghana
- Angaw Lagoon, in the Volta River deltaic estuary (20)

Cameroon and Congo
- Cameroon estuary complex, Cameroon (18); Rio-del-Rey estuary complex, Cameroon (18); Congo (Zaire) River estuary, Democratic Republic of Congo (18)

South Africa
- Langebaan Lagoon (20); Berg River estuary, Western Cape (20); Breede River estuary, Western Cape (20); Knysna Lagoon, Western Cape (18, 20); Gamtoos River estuary, St Francis Bay, Eastern Cape (18); Great Fish River estuary, Eastern Cape (20); Kariega River estuary, Eastern Cape (20); Kromme River estuary, St Francis Bay, Eastern Cape (18); Sundays River estuary, Algoa Bay, Eastern Cape (18); Swartkops River estuary, Algoa Bay, Eastern Cape (18); Mhlathuze River estuary, KwaZulu-Natal (18); Mvoti River estuary, KwaZulu-Natal (20); Nhlabane River estuary, KwaZulu-Natal (20); Thukela River Estuary, KwaZulu-Natal (18)

This is the twenty-second 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

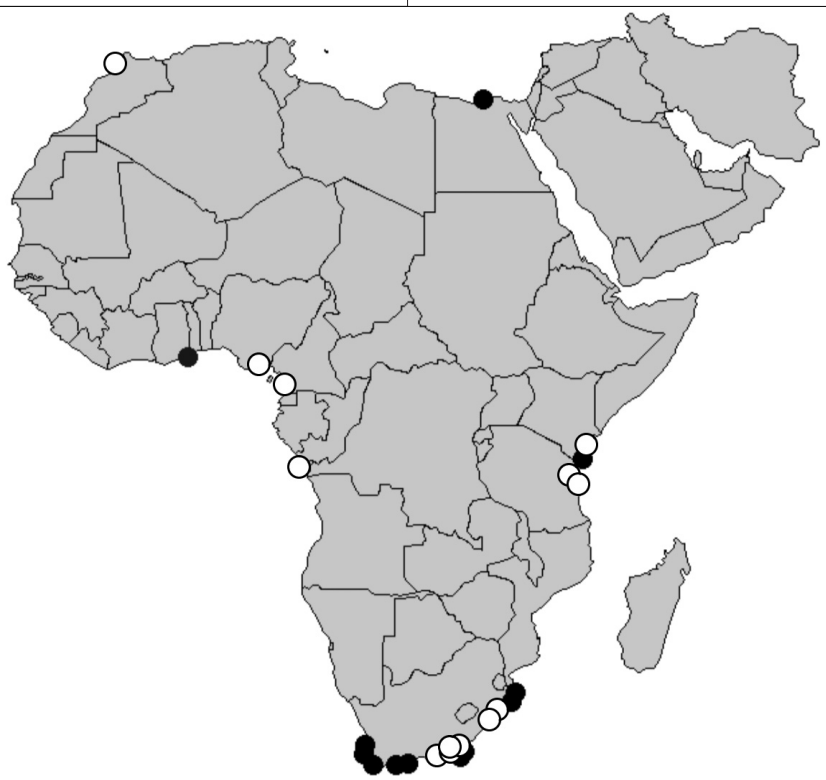

Figure 1. Biogeochemical budget sites – white circles, R&S Vols 18/19; filled circles, R&S 20.

Tanzania and Kenya
- Gazi Bay mangrove creek, Kenya (20); Malindi Bay, Kenya (18); Chwaka Bay, Zanzibar (18); Makoba Bay, Zanzibar (18).

Some key outcomes and findings from the workshops:
Estuarine nutrient budgets and models represent a range of localities including small to large estuaries and coastal embayments exhibiting a wide range of N and P loads and marked seasonality between wet and dry season flow conditions across the temperate, sub-temperate and tropical and monsoonal locations. Budget models cover land-dominated and ocean-dominated systems, in some of which the dominance changes with season. Dry–wet season net metabolic performance changes were shown in some cases, wherein values changed (e.g., Malindi Bay, Kenya) and sign changed (e.g., Rio del Rey, Cameroon; Kromme River, South Africa). These changes reflected a combination of forcing from seasonal precipitation and the interactions of river flow/flushing with tides and ocean inputs affecting water residence times and nutrient loading.

Several of the sites were subject to population, land-use and water management control of flow rates, e.g., the Nile Delta, Moulay Bousselham Lagoon, the Volta Delta, the Great Fish River, the Knysna system and the Kariega system. The modified flow rates have implicit effects on the net metabolism of the systems.

In the assessment of estuarine metabolic performance, it was necessary to consider the estuarine systems as a multiple set of horizontal biogeochemical budget boxes to encompass the physical circumstances of salinity and mixing. In these cases, the inner (landward) and outer (seaward) "boxes" often showed different tendencies for net carbon metabolism and net nitrogen balance e.g., Knysna Lagoon, South Africa. The Congo River estuary provided an unusual case with the estuary being strongly influenced by deep ocean waters and an apparent remineralisation zone associated with a continental shelf submarine canyon.

Partially developed budgets, requiring further fieldwork reflect the disparity in data and coastal system research within the region.

A second effort strongly supported by UNESCO/ IOC, START and NORAD concentrated on the interaction of river catchments and coastal zones. As part of the global LOICZ Basins project, two AfriBasins workshops (2000 and 2001) used a standardised assessment and synthesis methodology following the DPSIR framework to gather and analyze current knowledge of catchment-based drivers affecting coastal systems and future trends. A multidisciplinary network of scientists integrated coastal, marine, land-use and demographic information into expert typologies of river–coast interactions. Results include a qualitative ranking of the key driver/pressure on systems allowing visualisation of hot spots or negative trends versus medium or low-level impact areas.

Information was up-scaled from single catchments, via sub-regions determined by either climatic, demographic or coastal conditions (expert judgement), to provide the "broad picture" at a continental level. Where available, quantitative data allow down-scaling to the localised management through estimates of critical loads and thresholds for coastal system stability or functioning. The assessments provide insights into potential catchment policy responses, such as:
- nutrient control and the implementation of best agricultural practices
- erosion control
- regulation of water by diversion and damming
- upgrading of sewage treatment plants especially in growing economies
- changes in rural land-cover
- regulatory changes in point and diffuse source discharges, and
- the demands of road traffic and tourism.

Nine sub-regions were identified within Africa, featuring specific sets of geomorphological and climatic characteristics (Figure 2).

They differ widely not only in the biophysical nature of their catchments but also in the availability and quality of existing data relating to their material fluxes (see also R&S 18/19/20 for net flux information in estuaries in these sub-regions):

- the Nile and
- the Congo, with little information available about land-based drivers and how they relate to coastal issues were assessed as single catchment sub-regions;
- the Red Sea was considered outside the scope of this assessment; as a highly arid sub-region it receives no major runoff but should be included in a full African sub-regional division;
- East Africa, featuring the small and medium size catchments under monsoonal forcing (seasonal flushing);
- Central and South Mozambique (again high seasonality in runoff characteristics and transboundary issues);
- South-east Africa, characterised by catchments subject to various human use patterns and plans in place for intensive damming (e.g., the Thukela), pressures in harbour areas e.g., Richards Bay, dune mining in Natal. This sub-region encompasses subtropical to the warm temperate zones;
- South West Africa, with limited river runoff to a coastal sea which is mainly dominated by the upwelling system of the Benguela Current;
- West Africa, featuring a variety of big rivers subject to major damming resulting in reduced sediment and water fluxes, severe coastal erosion and reduced coastal stability as a growing threat to the lagoon-based cities; and finally

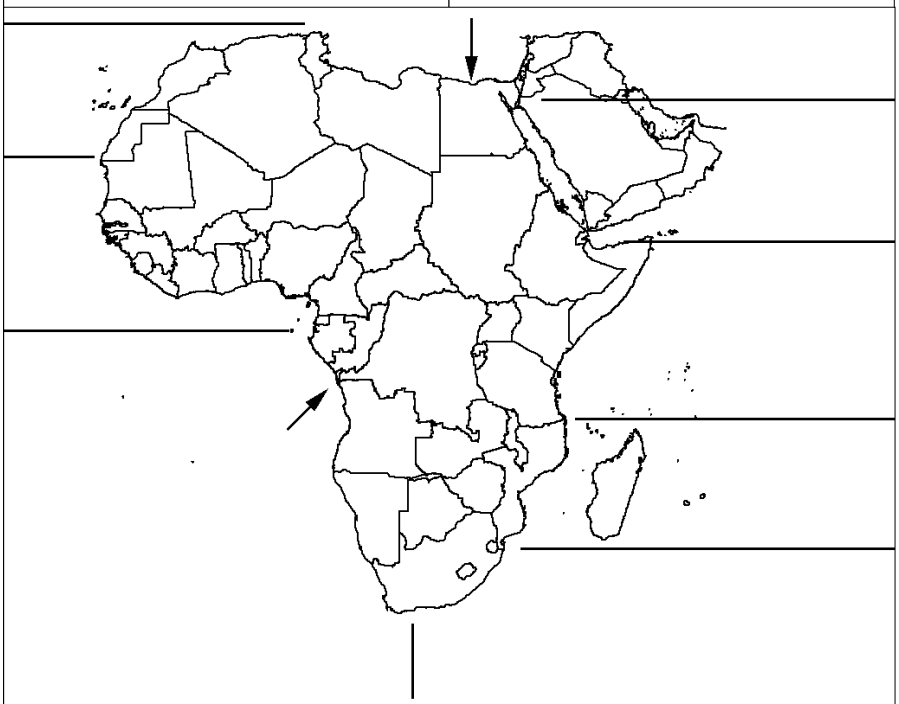

Figure 2. Sub-regions for the assessment of river catchment – coastal sea interaction in LOICZ workshops.

- North West Africa, an arid sub-region with seasonal runoff and, at least in Morocco, major human pressure through diversion and damming causing a variety of coastal change issues.

Catchments were selected subject to availability of data and considered as representative of a sub-region. Besides Africa's 'big four' river basins – Nile, Zambezi, Congo and Niger – important transnational-boundary basins such as the Gariep, Cross, Volta and Senegal rivers on the western coast, and the Limpopo and Incomati in the east were included. Medium and small basins have also been assessed, including the Sabaki and Tana rivers in Kenya, the Rufiji in Tanzania, the Thukela, Great Fish, Kromme and Groot Brak east of the Cape of Good Hope, the Olifants and Berg west of the Cape and the Sebou and Moulouya in Morocco.

Up-scaling to the regional African assessment

An initial ranking order was drawn up together with expected future trends in impacts (Table 1).

Table 1: Major activities (drivers), present status and trends affecting the coastal zone.

Anthropogenic drivers	Major state changes and impact	Present status	Trend expectations	Major areas affected (as for Figure 2)
Damming Diversion	Erosion Sedimentation	Major	Increasing	Almost all sub-regions, with Nile and West Africa as particular "hot spots"
	Salinisation	Local		(e.g., Incomati estuary, Moulouya plain)
	Nutrient depletion			(e.g., sites in KwaZulu-Natal, Morocco)
Various drivers	Biodiversity loss	Major	Increasing	Almost all sub-regions
Deforestation	Erosion Sedimentation	Medium		Medium ranking for most sub-regions, but major for coastal impacts generated in small and medium size catchments, e.g., Tana, Sabaki (Kenya) Moulouya and Sebou (Morocco)
Agriculture	Eutrophication Pollution			
Urbanisation				Medium overall but major in Nile sub-region
Industrialisation	Pollution			As above, but in most cases more coastal than catchment-based (e.g., Alexandria, Mombasa, Saldanha Bay)

Coastal geomorphological change involving erosion and sedimentation balances was a significant and progressive impact in nearly all sub-regions, the problem being acute in the Nile Delta and West African lagoon systems. Damming was the principal driver in such change, with consequent reductions in stream flow and sediment flushing. Damming was also seen as largely responsible for estuarine salinisation, e.g., the Incomati River in Mozambique, and nutrient depletion in the coastal sea, e.g., off KwaZulu-Natal and Morocco. In most sub-regions, deforestation and agriculture were important drivers, particularly for coastal sedimentation from medium and small catchments, e.g., the Tana and Sabaki Rivers in Kenya. Human settlement was a major contributor to eutrophication and the proliferation of aquatic weeds in the large West African catchments. Elsewhere, while eutrophication and pollution were recognised, they were mostly restricted to local (coastal) urban-industrial sources, e.g., Alexandria, Mombasa, Saldanha Bay and Cape Town. Loss of biodiversity or biological functioning was seen as another common issue, related to a complex interplay of human and natural drivers.

In general these data are characteristic of developing economy situations where economic growth and water use exceed the development of the necessary urban and industrial infrastructure. The results mirror those from the South American (SAmBas), and East Asian Basins (Lacerda et al. 2001, Hong et al. in prep.). However, the heterogeneity of the African sub-regions seems more pronounced than in the other regions, making the ranking of issues and drivers in Africa a complex challenge.

The LOICZ Basins assessment is linking with existing initiatives, both scientific and management including: the African Centre for Wetlands (Ghana), the GEF MSP on "Development and Protection of Coastal and Marine Environment in sub-Saharan Africa" driven by the Advisory Committee on Protection of the Sea (ACOPS), and UNESCO/IOC programmes. As with the biogeochemical estuarine assessments, the scarcity of standardised data (scientific or socio-economic) is a recurrent problem in most of the sub-regions. Time-series data are particularly sparse. The workshops highlighted a dearth of knowledge about the critical loads and thresholds of material fluxes cascading through the catchments to the coastal seas.

A shortlist of "hot spots" has been identified for future interdisciplinary research, perhaps following the EuroCat example (http://www.iia-cnr.unical.it/EUROCAT/ project.htm). This would parallel similar efforts in South America and East Asia. Meanwhile, AfriBasins and the estuarine biogeochemical assessments can rely on a growing interdisciplinary network of scientists who are also exposed to training opportunities within the LOICZ framework and beyond to help build regional capacities. A Basins website has recently been set up and can be accessed through www.nioz.nl/loicz/.

References

IOC 1999 GOOS – Africa: Global Ocean Observing System for SICOM. IOC Workshop Report 152 (GOOS Report 62), UNESCO, Paris.

IOC 1999 GOOS – Africa: Global Ocean Observing System for SICOM. IOC Workshop Report 152 (GOOS Report 62), UNESCO, Paris.

START/IOC/LOICZ Workshop on climate change and coastal processes in West Africa (in preparation).

Dupra, V., S.V. Smith, J.I. Marshall Crossland and C.J. Crossland (eds) 2001 Estuarine Systems of sub-Saharan Africa: C, N and P Fluxes. LOICZ R&S 18, 83 pages.

Dupra,V., S.V. Smith, J.I. Marshall Crossland and C.J. Crossland (eds) 2001 Coastal and Estuarine Systems of the Mediterranean and Black Sea Regions: C, N and P fluxes. LOICZ R&S 19, 101 pages.

Dupra, V., S.V. Smith, L.T. David, H. Waldron, J.I. Marshall Crossland & C.J. Crossland (eds) 2002 Estuarine Systems of Africa (Regional Workshop II): C, N and P Fluxes. LOICZ R&S 20, 81 pages.

Lacerda, L.D., H.H. Kremer, B. Kjerfve, W. Salomons, J.I. Marshall Crossland and C.J. Crossland (eds) 2002 South American Basins LOICZ Global Change Assessment and Synthesis of River Catchment – Coastal Sea Interaction and Human Dimensions. LOICZ R&S 21, 212 pages.

Hong, G.H. et al. (in preparation) East Asia Basins LOICZ Global Change Assessment and Synthesis of River Catchment – Coastal Sea Interaction and Human Dimensions. LOICZ R&S.

LOICZ IPO NOTES

Synthesis and futures

In 2001, we have two major activities on the go in LOICZ – the development of our "synthesis" of the last 9 years of LOICZ, and the preparation of a future Science Plan for LOICZ II.

The work on synthesising the finding of LOICZ to date is progressing and will form a major theme for discussion at the LOICZ Synthesis and Futures meeting in Miami in late May. A large number of "LOICZ scientists" are working on the synthesis and more people are being enlisted in the effort through coordination of lead authors for the various chapters of the synthesis book. The book is planned for publication in early 2003 with Springer, as part of the IGBP Series of Syntheses from core projects of IGBP.

A LOICZ Futures discussion document, initially built on LOICZ SSC considerations, is being circulated widely to individual scientists and interested agencies and groups. A draft version will be a second theme of consideration at the Miami meeting in May, where scientists, potential sponsors and science-user agencies will be represented. From those discussion a draft Science Plan for LOICZ II (2003-2012) will be prepared through the latter part of 2002. An iterative process of drafting and inclusion of comments is underway as we work towards defining a set of questions and strategies for additional scientific assessment of global change in the coastal zone. If you have not received a copy and would like to participate in this planning, contact the LOICZ IPO.

Supportive to both the Synthesis and Futures activities of LOICZ is the continued writing and preparation of substantive reports addressing regional evaluations of coastal catchments and coastal seas. New LOICZ Reports and manuscripts in science journals continue to be produced and form a tapestry of findings from LOICZ activities especially from local and regional research. This work continues unabated as do discussions with science-users to promote application of our science.

A new LOICZ programme of actions from 2003 will require continued support from a global network of scientists. We look forward to your continued support and involvement through and beyond this current transition period.
In addition the LOICZ Scientific Steering Committee is engaging in discussions with a number of national and international governments and agencies seeking funding and other contributions to the support and development of the new program, and sustenance for our existing efforts. Encouragingly, we are having strong interest shown in LOICZ - now and for the future.

LOICZ web-site

Our web site is being updated and extended to provide access to a wider range of core activities. The ***Biogeochemical Budgets and Modelling*** and ***Typology*** web-sites are a click away from the LOICZ web-site, and both core project sites continue to expand with new information, assessments and tools.

Two new web sites in LOICZ have been added and are accessible:

The work of the LOICZ ***River Basins*** network is now available on the web and under continuing expansion with new and novel information pressures and changes in continental river basins and effects on material flows.

The ***Deltas Management*** web site is accessible and a network group is building a profile of management actions and assessment of effectiveness of management approaches and how these are influencing deltaic systems. The main focus is on major deltaic regions of the world.

Dutch LOICZ and associated research

The Netherlands government continues to provide the vital support needed for the LOICZ IPO and to assist in the overall science activities of LOICZ. In addition the Netherlands government, through NWO, recently approved five research projects within a new and significant Dutch LOICZ programme involving several million Euro in funding, including:

- Budgeting of carbon and related nutrient pools and fluxes in the North Sea employing a coupled hydrodynamic ecosystem model (PI: Dr Helmuth Thomas; NIOZ).
- The transport of suspended particulate matter in the Dutch coastal zone (PI: Dr H. Ridderinkhof; NIOZ, Delft Technical University, RIKZ, IMAU).
- Archeal carbon fixation and burial and terrestrial organic matter input in the coastal system as revealed by tetraether membrane lipids (PI: Dr Sinninghe Manste; NIOZ, NIOO).
- Bio-geomorphological interactions within floodplains and their role in sediment transport and ecological transformation processes in the lower Rhine delta (PI: Prof. E.E Koster; Utrecht University, University of Nijmegen).
- Mechanisms involved in salt-marsh rejuvenation (PI: Prof. J.P. Bakker; University of Groningen, NIOO, Alterra, RIKZ).

This new regional work is extended from recent approval of substantial new research projects by the Flemish-Dutch Coastal-associated Marine Research on:

- The balance between heterotrophic amd autotrophic processes in the Scheldt Estuary: consequences for the carbon and nitrogen cycles (Co-Pis: Dr D. Frank & Dr J. Middelburg: University of Brussels, NIOO).
- Diversity – productivity relationships in microphytobenthos (Co-Pis: Dr V. Wim & Dr S. Lucas; University of Gent, NIOO).
- Food, oxygen and bioturbation: an experimental study of meiofauna community structure (Co-Pis: Dr V. Magda & Dr H. Peter; University of Gent, NIOO).
- Tidal freshwater marshes as processors and sinks of nitrogen in estuaries: a whole ecosystem 15M-labeling study (Prof. P. Meire & Dr H.T.S. Boschker; University of Antwerp, NIOO).

IGBP Integration and New Quanta

Clearly, the International Geosphere-Biosphere Programme parent of LOICZ has made extraordinary contributions to scientific understanding of the biogeochemical processes and function of the planet during its decade-long research to date. This was notably demonstrated at the IGBP Congress (with allied global research programs of International Human Dimensions Programme and World Climate Research Programme) in Amsterdam, July 2001
(see http://www.igbp.kva.se).

A February meeting of the IGBP-Scientific Committee in Stockholm consolidated and extended this view in discussions of new research findings and direction for the evolving IGBP II

programme. IGBP core projects outlined their progress and findings in the last year and reported on the many "syntheses" activities underway as many of the projects complete their first decade of IGBP work. Over the next 18 months, a number of global assessments will be published that integrate the regional and global scales of our understanding of integral parts of the Earth. These "syntheses" are a vital and compelling dimension to the multitude of published papers describing small pieces of the jigsaw – the "bigger pictures" are being further distilled in an integrated Earth System canvas by work of the IGBP-SC.

In addition to the science outcomes, the continued commitment of a large network of researchers and their supporting institutions is evident – indeed, fundamental to the function and successes.
Also apparent, is the increasing collegiate nature of the elements of IGBP working for synergy to achieve goals and explore new dimensions. The new IGBP program and the collaborative Global Environmental Change partnership alliance with IHDP, WCRP and Diversitas will provide a new set of opportunities.

IGBP is advancing well with its development of new plans for the IGBP II program. Three "compartment" projects (land, air, ocean), three "interface" projects (land-ocean, land-atmosphere, ocean-atmosphere) and two "integrating projects" (GAIM and PAGES) are building new science plans to address key questions across a time span of 2003-2012. The wider global science community is involved or being asked to contribute to this work.

The Earth System Science Partnership of programmes (IGBP, IHDP, WCRP, Diversitas) has developed as a collaborative alliance that should add a new and exciting dimension to new global environmental studies, affecting individual to programmatic work and opportunities. Joint programmatic studies of big questions – carbon, food, water – have been identified for fully collaborative approaches and planning and research is in progress.

A full description of the plans, progress and initiatives will be a feature of the next IGBP Newsletters (available in hard copy of through the IGBP web site in the next few months). In the meantime, the IGBP web site provides evolving information that should be of interest to all LOICZ associates.

"Coastal Change and the Anthropocene" LOICZ Synthesis and Futures Meeting, 29 May – 01 June 2002, Rosenstiel School for Oceanography, Miami

After 10 years drawing on the extensive collaborative research provided by a network of more than 2000 scientists around the world addressing Global Change in the coastal zone, LOICZ aims to synthesise its major findings and to identify priority directions for future work on coastal change issues within the Earth System Science Partnership (ESSP) of IGBP, IHDP, WCRP and Diversitas.

With a selected group of key scientists bringing together the broad geographic and scientific scope of LOICZ research from the last decade the Synthesis and Futures Meeting will be held in Miami, USA 29 May-01 June 2002. Taking a two-pronged approach, the Meeting will be the final forum to wrap up and to:

a) deliver a first integrated assessment of global change in the coastal zone, dealing with material flux models and processes, and the human dimensions, and
b) derive key implications for changing coastal environments under natural and anthropogenic forcing that will direct the identification of priority scientific questions to be addressed in the future.

The task is to review and refine the integrated results and to promote discussions to enable the updating of the various chapters that will form the first global LOICZ assessment report to be published early 2003. The Meeting comprises plenary and working group sessions arranged along the topics of the major LOICZ synthesis chapters, which are:

A: LOICZ work to date:

- Coastal Habitats and Living Resources: Changing habitats on land and in the coastal seas, and changing resources. (Chapter 2)
- Water and the Coastal Zone: River Basin-Coast Interactions: Land – based drivers affecting the flow of substances to the coastal zones critical loads and trends of coastal change and human dimensions. (Chapter 3)
- Dynamics of the Coastal Zone: Fate and process of materials including sediments and "non-reactive" matter. (Chapter 4)
- Impacts and Feedbacks of Changes in C, N and P Cycling in the Coastal Zone: Fate and process of chemically reactive materials carried in the coastal sea. (Chapter 5)
- Science for Management in the Coastal Zone: Hot issues, key findings and implications of the LOICZ programme. (Chapter 6)

B: Future Questions and Issues:

Based on the synthesis and gaps identified in the second part of the Meeting, plenaries and Futures working groups will include views on LOICZ invited from other programmes addressing Earth Systems Interfaces and Change such as Ocean–Atmosphere (SOLAS), Land–Atmosphere–Water (including GLOBEC and PAGES). Priority will be given to the integrated questions in the broader human and institutional dimensions context such as "System, Space and Human Dimensions". Five working groups will address:

1. River Basins and Human Dimensions
2. Spatial Issues: Implications of Land and Sea Use Changes in the Coastal Zone
3. Fate and Transformation of Materials in Coastal and Shelf Waters
4. System Sustainability and Resource Management Issues
5. Risk and Vulnerability Issues

These thematics are still liable to change since they reflect the current stage of discussion in our dynamic process of engaging community response to the future shaping and design process. The working groups will address key issues and refine scientific questions for future coastal change research in order to provide for the development of a science plan for LOICZ beyond 2002.

Preliminary draft outlines, parts or even larger blocks of the LOICZ synthesis chapters as well as a working document on the futures form the background for discussions and will be distributed to participants prior to the meeting. You'll find a draft programme on the LOICZ web-site http://nioz.nl/loicz/ - click on the "New" button.

COMING. . .

The next LOICZ newsletter will feature:

The use of scenarios in integrated environmental assessment of coastal-catchment zones: the case of the Humber Estuary, U.K.

by L. Ledoux, R. Cave and R.K. Turner, *CSERGE, School of Environmental Sciences, University of East Anglia, Norwich, UK.*

HAVE YOU SEEN

IGBP Science Series Publications
A fascinating series of scientific outcomes in summary from IGBP and the core projects.
A new volume will be added to the Series as each IGBP core project completes its "synthesis".

- Ocean Biogeochemistry and Global Change.
  IGBP Science No. 2, 2001 (JGOFS)
- Environmental Variability and Climate Change.
  IGBP Science No. 3, 2001 (PAGES)
- Global Change and the Earth System: A planet under pressure.
  IGBP Science No. 4, 2001 (IGBP)

Copies are available from the IGBP Secretariat in electronic form (http://www.igbp.kva.se) and hard copy (email: sec@igbp.kva.se). LOICZ IPO can assist you if electronic access is a constraint.

Land-Ocean Interactions in the Coastal Zone: Special Issue
(Journal of Sea Research Volume 46, Issue 2, 2001) Collected papers describing some steps taken by LOICZ scientists to improve our understanding and advancing novel ideas and approaches in coastal zone research.

Topics include: coastal classification, groundwater, radiation boundary conditions, biogeochemical models, estuarine temperatures and heat fluxes, estuarine freshwater transport, sampling submarine aquifers.

WHAT'S ON THE WWWEB

All these sites are accessible via the LOICZ web-site.

Biogeochemical Budgets and Modelling – new sites and tutorial materials (http://data.ecology.su.se/MNODE/)

Typology web-site: (http://water.kgs.ukans.edu:8888/public/Typpages/index.htm) and (www.kgs.ukans.edu/Hexacoral/Workshops)

NEW LINKS:
Basins:
http://w3g.gkss.de/projects/loicz_basins/
Deltas management:
http://www.deltasnetwork.nl
South Asia Coastal Fluxes:
http://www.coastal-fluxes.slt.lk

LOICZ PUBLICATIONS

LOICZ publications are available as printed copies and are also downloadable from the LOICZ web-site.

Estuarine Systems of Africa (Regional Workshop II): C, N and P fluxes. Eds. V. Dupra, S.V. Smith, L.T. David, H. Waldron, J.I. Marshall Crossland and C.J. Crossland. LOICZ R&S 20, 2002. LOICZ UNEP workshop report.

South American Basins LOICZ Global Change Assessment and Synthesis of River Catchment – Coastal Sea Interaction and Human Dimensions. Eds L.D. Lacerda, H.H. Kremer, B. Kjerfve, W. Salomons, J.I. Marshall Crossland and C.J. Crossland, LOICZ R&S 21, 2002. LOICZ UNEP, UNESCO/IOC and CNPq workshop report.

LOICZ/UNEP Regional Synthesis Workshops: Australasia-Asia, the Americas, Africa-Europe, Summary Report and Compendium. Eds. R.W. Buddemeier, C.J.Crossland, B.A. Maxwell, S.V. Smith, D.P. Swaney, J.D. Bartley, G. Misgna, V.C. Dupra and J.I. Marshall Crossland. LOICZ R&S 22, 2002. LOICZ UNEP workshops report including CD-ROM.

LOICZ CALENDAR

LOICZ SSC Meeting 27 May & 2 June 2002, Miami, Florida, USA

LOICZ Synthesis and Futures meeting, 29 May–1 June 2002, Miami, Florida, USA (by invitation). Contact LOICZ IPO.

OTHER MEETINGS

Joint Water Project of WCRP/IGBP/IHDP/DIVERSITAS, 8-10 May 2002, Paris, France. For information please contact Carlo Jaeger at: carlo.jaeger@pik-potsdam.de or Charles Vorosmarty at: charles.vorosmarty@unh. edu

7th International Estuarine Biogeochemistry Symposium, 28-30 May 2002, Grimstad, Norway. For information please contact: http://www.niva.no
International Symposium on Low-Lying Coastal Areas: Hydrology and Integrated Coastal Zone Management. 9-12 September 2002, Bremerhaven, Germany.
Contact Alicia Aureli, UNESCO (a.aureli@unesco.org).

Joint IAMAS/CACGP/IGAC Scientific Conference on Atmospheric Chemistry in the Earth System: From Regional Pollution to Global Change, 15-18 September 2002, Crete, Greece. Abstract deadline submission March 2002.
Contact: igac2002@chemistry.uoc.gr Visit: http://atlas.chemistry.uoc.gr/IGAC2002

11th International Biennial Conference on Physics of Estuaries and Coastal Seas (PECS'02), September 17-20, 2002., Hamburg, Germany. For information visit: http://www.pecs-conference.org.

34th COSPAR Scientific Assembly and Second World Space Congress, 10-19 October 2002, Houston, Texas, USA. For information visit: http://www.copernicus.org/COSPAR/COSPAR.html

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