# LOICZ

# ANNUAL REPORT
# 2003


**LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE**

**Contents**

## About LOICZ

The world's coastal zone forms a variable, multi scale boundary between land and ocean highly valued by human societies. Since 1993 Land-Ocean Interactions in the Coastal Zone (LOICZ) is a core project of the International Geosphere-Biosphere Programme (IGBP) on Global Change of ICSU studying this heterogeneous, relatively small but highly productive, dynamic and sensitive area of the earth's surface. The scientific contents of the project is supervised by an international Scientific Steering Committee (SSC) supported by an IPO which was established in 1993 and is hosted by the Royal Netherlands Institute for Sea Research (NIOZ) at Texel. Funding for IPO operations and synthesis has generously been donated by the Netherlands government including, since 2003, a three year transition period towards a new decade of LOICZ. .

The focus of LOICZ research is on horizontal material fluxes and scaling of processes through environmental and socio-economic sciences. It depends on national research programs and contributions from individual scientists, and works with researchers to develop collaborative and multidisciplinary projects to meet the goals. LOICZ aims to value-add to the global knowledge base through focussed expert workshops and initiating new research. While the LOICZ Implementation Plan (1995) describes in detail the purpose of the first decade of LOICZ including key topics of its ongoing synthesis:

- Is the coastal zone a sink or source of $CO_2$?
- What are mass balances of carbon, nitrogen and phosphorus in the coastal zone?
- How are humans altering these mass balances, and what are the consequences?
- What is the role of the coastal zone in trace gas (e.g., DMS, NOX) emissions?

gaps identified during LOICZ I and input coming from a broad, iterative discussion engaging the global science community and institutions have shifted the focus to questions that try to highlight the people and management dimension of the horizontal fluxes, e.g.,:

- How do changes in land use, climate and sea level alter the fluxes and retention of water and particulate matter in the coastal zone and affect coastal morphodynamics?
- How can knowledge of the processes and impacts of biogeochemical and socio-economic changes be applied to improve integrated management of the coastal environment?

This first year, 2003, of the "New" LOICZ was characterized by a revision and consolidation of initial plans for a second decade in which a redesigned LOICZ is expected to become the major contributor of interdisciplinary coastal science to the IGBP II and the Earth System Science Partnership of IGBP, IHDP, WCRP and DIVERSITAS. Restructuring was pursued successfully regarding the SSC, the IPO and a first official draft Science Plan and Implementation Strategy had been developed jointly with the IHDP. This engagement with the Human Dimensions has reached a formal state and is expected to improve LOICZ' interdisciplinarity

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## 1. CHAIR'S REPORT

2003 was the first year of the second decade of LOICZ, thus a critical one for the future of the project. Consequently throughout the year, the LOICZ SSC has consulted widely to identify the scientific gaps through a process of ongoing synthesis leading to development of the key new research themes for the LOICZ II. A final internal synthesis workshop held on Texel invited the lead authors of the LOICZ I book to distil those key findings and gaps into a final Chapter that looked at the successful outcomes of LOICZ I and looked forward to the challenges of LOICZ II.. However, production of the final draft chapters has turned out to be more time consuming than expected so that publication is not anticipated before early 2005.

Irrespective of this delay, the first global synthesis of nutrient fluxes and C, N and P metabolism in the near shore coastal seas from more than 200 study sites, and which included the identification of simple land-based proxies, has led to a predictive capacity for coastal metabolism: This has had a major influence on the development of the LOICZ II. Changing material fluxes entering coastal seas via river catchments reflects a complex interplay between global climate change and anthropogenic influences across a broad variety of spatial and temporal scales. The synthesis has underlined that the scale of small and medium size catchments are the most important with regard to pronounced effects on the coast. In principle the river catchment – coast continuum scale will receive priority attention in LOICZ II themes. It has also become clear that LOICZ II needs to work across global, regional and local scales and has to deliver science that informs the new global scale Earth System Science questions, as well as the national and regional scales of management and decision making. For this purpose LOICZ needs to further develop its typology approaches and tools, and interface more closely with the related projects and policy institutions that benefit from this kind of science.

Consequently LOICZ has intensified its engagement with the IHDP Human Dimensions Community and worked with a joint scoping team to provide a new draft science plan and implementation strategy that entered a peer review by IGBP at the beginning of 2004. In parallel efforts, a formal agreement between LOICZ and IHDP for co-sponsorship has been pursued, which has reached the stage of official SSC/SC considerations. As a concrete step a group of potential human dimensions oriented SSC members to join the LOICZ SSC in 2004 has been identified for consideration by the IHDP.

Further co-sponsorship was indicated by the SCOR Executive Committee at the IGBP SC Meeting in Punta Arenas, Chile. Their support will focus on activities dealing with "*Fate and transformation of materials in coastal and shelf waters"* and will assist in improving the operational links and joint activities with related IGBP and IOC projects such as SOLAS, GLOBEC, IMBER and the Global Ecology and Oceanography of Harmful Algal Blooms project (GEOHAB). In a first activity, SCOR and LOICZ, supported by IAPSO, agreed to provide 3 years co-funding to the new working group "Mechanisms of Sediment Retention in Estuaries". We are also glad that UNESCO/IHP, the UNEP/GPA and its Freshco Partnership joined the group of partners fostering LOICZ science becoming co-sponsors in various scientific activities of mutual interest. LOICZ will continue to build and expand these links.

Critical input to LOICZ for its sensitive transition period, and proper determination of its role in the new Earth System Science Partnership of IGBP, IHDP, WCRP and DIVERSITAS, was gained at the 3rd IGBP Congress "Connectivities in the Earth System" held in Banff, Canada, 19-24 June. Collaboration across project interfaces was of key concern for LOICZ. Therefore, we have contributed to, or taken the lead in, various working groups with IMBER, GLOBEC, the GWSP and GECAFS. As a follow up, LOICZ contributed actively to the further development of the IMBER science plan including arrangements for two way collaboration, *dito* with SOLAS, GLOBEC, LAND and the HD projects. In late 2003 we

participated in the Data Management workshop supported by SCOR. Issues on how to effectively collaborate and avoid duplication and competition within the IGBP and beyond with ESSP joint projects still call for strong leadership and guidance, which will largely be up to the core projects.

The engagement with IHDP in Banff has finally resulted in a first joint activity involving GECHS, GLOBEC, IDGEC and IGBP-LOICZ in a coastal panel "Global Environmental Change and Coastal Systems: A Microcosm of Coupled Human-Environmental Systems" at the HD Open Meeting in Montreal in October. This was encouraging and it has been agreed to join hands in synthesising specific scientific questions and to further investigate options for project-based cooperation.

Critical for the LOICZ II was the 14th LOICZ SSC meeting held during the Banff Congress. High up in the Canadian Rocky Mountains we welcomed more than 50% new members and discussed the directions for the next decade of LOICZ in light of the Congress. The SSC approved a set of major changes including a restructuring of the SSC itself and the distribution of the IPO, collaboration with sponsors and operational approaches for cooperation in ESSP. In a nutshell, the restructuring underlines that the scientific community has given priority to both sustainability and management related research topics interfacing with the human dimensions and to a visible improvement of LOICZ' regional performance and networking. This follows the recommendations of the 2002 review panel.

In the process of distributing the IPO we are glad that since mid 2003 a first Regional Node started operations at the Nanyang Technological University, Environmental Engineering Research Centre, Singapore, (Prof. Lawrence Koe, ccckoe@ntu.edu.sg). A second Node is almost ready to start and will be located at the Institute for Coastal Research at the GKSS Research Centre, Geesthacht, Germany (floeser@gkss.de). Further options are being explored with other countries, in particular Australia, Sri Lanka, Africa and America.

The good and hard work at the IPO continued although initially constrained by an unclear funding situation resulting in a series of very short term contracts for Hester Whyte and Hartwig Kremer (who took over the EO position from Chris Crossland). In this context, Mildred Jourdan after a long commitment to LOICZ had to leave during this period so that for most of the year the IPO had to operate with only two people. However, the good news came in early summer when it turned out that, thanks to the strong efforts of the Dutch funders and the IPO, a budget could be tied together safeguarding a solid financial basis for IPO operations at the Royal NIOZ on Texel for the whole transition period 2003-2005. With this decision the consortium of NWO, RIKZ and the Dutch Climate Research Programme under VROM fully followed the recommendations of the independent evaluation panel made in 2002 allowing LOICZ to properly consolidate its new structure and to get its new science on the way. We are most grateful for this extended generous Dutch support now summing up to a total of 13 years.

Following the consolidation, in late autumn the IPO advertised a Deputy Executive Officer position and after an extended series of interviews with a variety of highly skilled and enthusiastic candidates the position was filled by Dr Martin LeTissier from ENVISION Partners in Newcastle, UK (taking effect in January 2004). Again LOICZ is pioneering here in engaging with a company but we are sure it will be to the benefit of all parties and in particular allow the Texel IPO to act most effectively in the remaining 2 transition years.

We even didn't let Chris Crossland off the hook totally. Though obviously enjoying the "blessings and curses" of retirement Down Under he has been contracted to assist in the LOICZ synthesis as the focal point for the internal editorial process. With the charming and professional support of Jan Crossland the two provide invaluable help for the IPO allowing it to concentrate on the complex tasks of shaping the new science and restructuring LOICZ.

In conclusion, yes, our future is taking shape and 2003 successfully set the stage for this transition although much work remains to be done by ALL involved in LOICZ. In particular the SSC is challenged to give its maximum input to ensure successful guidance of the transition process. After a successful first year of the LOICZ II, even more challenging years await us as our future gets more and more into shape positioning LOICZ as a flexible, truly interdisciplinary and rolling synthesis and advice mechanism for coastal sciences and management. Other challenges remain that will keep a high work load on the IPO and SSC, such as establishing a strong network of Regional Nodes and finding a country and institution willing and capable to host the central IPO after 2005. These will be critical issues in the near future without which LOICZ will hardly be able to operate effectively.

Maintaining or re-establishing momentum for further development of approaches, methods and networks of the first phase that provide an invaluable legacy and have implications for LOICZ II, such as the typology and coastal metabolism research and their underlying databases as well as the water continuum focus.

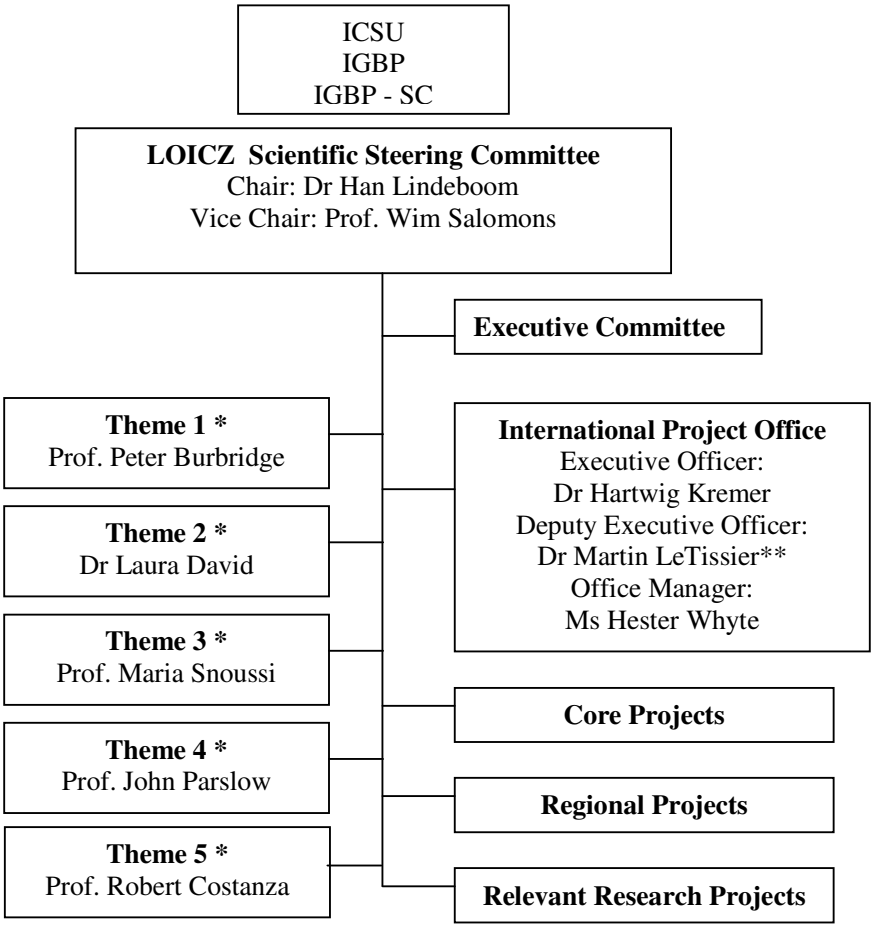
At the end of 2003 I personally handed over the chairmanship to my SSC colleague, Assistant Professor Liana Talaue McManus, whom I wish all the strength, success and support necessary in this demanding phase of the LOICZ II. For the next two years I will keep involved as a past chair and assist to secure the future of LOICZ.

Han Lindeboom
**Chair**
**LOICZ Scientific Steering Committee**

## 2. ORGANISATION AND STRUCTURE

Land-Ocean Interaction in the Coastal Zone (LOICZ), was established by IGBP in December 1992 with the adoption of the LOICZ Science Plan (IGBP Report No. 25, 1993) and Implementation Plan (IGBP Report No. 33, 1994) and became the sixth core project of IGBP (itself a program of ICSU). During the Cuernavaca, Mexico, and Chiang Mai, Thailand, IGBP SC Meetings in 2000/01 LOICZ has been identified as a continued mechanism to inform the new phase of Earth System Sciences on key processes and scenarios of global coastal change in close partnership with IGBP and Human Dimensions projects.

The following scheme and table represents the organisation of LOICZ in 2003 following from recommendations by the 13th LOICZ SSC Meeting in Miami, 2002 and the subsequent nominations by the IGBP Officers. Beginning in 2004 the SSC will be restructured, i.e. expansion to 25 members including an intial provision of four openings for experts from the social science disciplines. They will be filled following decisions expected from the IHDP SC Meeting in March 2004 concerning the formal set-up of the IHDP LOICZ semi-"parentship"/co-sponsorship. Suggestions have already been made by LOICZ and the IHDP project chairs.




**LOICZ Organisation Schema 2003, (* = Theme leaders appointed by the 14th SSC in Banff ; ** = taking effect from January 2004)**

The **Scientific Steering Committee (SSC)** provides scientific guidance and oversees the development, planning and implementation of the LOICZ Core Project. The IGBP Science Committee (IGBP-SC) established the SSC and is also responsible for the subsequent appointment of the Chair, Vice-Chair and members.

***SSC Membership***

| | |
|---|---|
| Dr Han Lindeboom (Chair) | Netherlands Institute for Sea Research, The Netherlands |
| Prof. Wim Salomons (Vice-Chair) | Free University, Amsterdam, The Netherlands |
| Prof. Peter Burbridge | University of Newcastle, UK |
| Dr Laura David | University of the Philippines, Manila, Philippines |
| Prof. Maria Snoussi | University of Rabat, Morocco |
| Prof. John Parslow | CSIRO Marine Research, Hobart, Australia |
| Prof. Robert Costanza | University of Maryland/moved to Delaware |
| Prof Anthony Forbes | University of Natal, Durban, South Africa |
| Dr Weigen Huang | State Oceanic Administration, China |
| Prof. Luiz Drude de Lacerda | Universidade Federal do Ceará, Fortaleza, Brazil |
| Prof. Michel Meybeck | University of Paris IV, Sisyphe, Paris, France |
| Dr Jozef Pacyna | NILU, Norway |
| Dr Gerardo M.E. Perillo | Instituto Argentino de Oceanografica, Argentina |
| Dr Yoshiki Saito | Geological Survey of Japan, AIST |
| Prof. Shu Gao | Nanjing University, China |
| Prof. James Syvitski | Institute of Arctic and Alpine Research, Colorado, USA |
| Dr Liana Talaue McManus | Rosenstiel School for Marine and Atmospheric Science, University of Miami, Florid, USA |

Ex officio members

| | |
|---|---|
| *Prof. Frederik Wulff* | *Stockholm University, Sweden* |
| *Prof. Stephen V. Smith* | *University of Hawaii, USA* |
| *Dr Robert W. Buddemeier* | *University of Kansas, USA* |

*All three were involved in 2002 SSC activities reflecting their crucial contribution to the synthesis process and in accordance with earlier determination of the SSC and IGBP.*

The SSC 14 met on 19 and 24 June, 2003 in Banff, Canada.
The **Executive Committee** (EXCOMM) is a subcommittee of the SSC that, at the direction of the SSC, deals with special issues and reports to the SSC with recommendations. The EXCOMM in LOICZ II comprises the SSC Chair, Vice-Chair and the Theme Leaders.

While the EXCOMM did not meet in 2003, designated theme leaders (after identification at the Banff SSC *) maintained and intensified their strong interaction with the IPO throughout the second half of the year, in particular in their role as lead authors for the SPIS. A sub-group of them also met with the IHDP scoping team members one day prior to the SSC in Banff to prepare and finalise inputs to the SPIS discussions.

Scoping team members form IHDP projects were:
Elena Andreeva, Russia – ex IDGEC; Rudolf de Groot Germany/Netherlands – Ecol. Economics; Felino (Ino) Lansigan, Philippines - LUCC, William D Solecki, USA – Urbanisation Initiative; Aaron Wolf, USA - GECHS;

With two exceptions, LOICZ I Synthesis lead authors met for a final meeting in Texel in early December (Buddemeier, Burbridge, Crossland, Swaney (representing also Smith). The meeting mostly addressed those findings in each of the individual chapters that need to be reflected and put into a broader context in the concluding chapter. A guiding role of this

chapter is also anticipated for the development and refinement of the LOICZ II SPIS and future research issues.

**LOICZ scientific structure**

The original **Foci** structure of LOICZ terminated with the end of 2002. Therefore, based on the SSC decision that in LOICZ II a "**Theme Structure**" will provide the underlying framework for implementation, the organisation scheme shown above already refers to the new themes. They are marked with an asterisk (*) in order to indicate that they are still under discussion and changes in wording and sequence during the finalisation of the Science Plan and Implementation Strategy, SPIS, cannot be ruled out.

Obviously the new Themes in 2003 haven't fully evolved into key programme activities of LOICZ II. They have, however, started to guide the discussions and shape the first draft SPIS version with the SSC and beyond including the interdisciplinary scoping team with IHDP (see above). It is anticipated that in the future the Themes will set a broader frame accommodating a flexible agenda of scientific priorities that will be subject to regular review where major priorities and production lines will be determined.

The division of projects contributing to LOICZ into;

- **Core Projects,** which directly address goals of the LOICZ Science Plan (the old and new one) co-ordinated by the SSC,
- **Regional Projects,** which are closely linked to the Science Plan (but may have additional aims) and are co-ordinated at regional levels, and
- **Relevant Research Projects,** which make a scientific contribution to LOICZ, often at local or thematic levels,

has been left unchanged. This seemed appropriate since, while various regional and relevant projects have been acquired in 2003, some core and regional projects are carried across from LOICZ I into the new phase, such as ELOISE, and regional budgeting activities, such as LaguNet. Activities of the project research elements and Themes of LOICZ are outlined in Section 3.

**IPO Organisation**

The **LOICZ International Project Office** (IPO) is responsible for the administration of the project on a day-to-day basis, under the strategic guidance of the SSC. The IPO's role includes: co-ordination, planning, communication, advocacy and provision of a technical secretariat. For the whole transition phase (2003-2005) it will remain located at the Royal Netherlands Institute for Sea Research, Royal NIOZ, Texel, The Netherlands.

In 2003 the LOICZ secretariat comprised: Executive Officer (Dr Hartwig Kremer), Office Manager (Ms Hester Whyte), and P/T Administrative Officer (Ms Mildred Jourdan) who left the IPO in June 2003. Contracted editorial work was carried out by Ms Jan Crossland and Dr C. J. Crossland. Only at the end of the year could a Deputy Executive Officer position be advertised and in December Dr Martin Le Tissier, UK, accepted to take on this position taking effect officially from January 2004.

# 3. STATUS REPORTS

## 3.1 SCIENTIFIC PROGRESS AND ACTIVITIES IN 2003

LOICZ has been continuously engaged in completing its 1993-2002 synthesis commitments and developing a new plan and appropriate operational structure for LOICZ II (2003+) that fits the evolving direction of the ESSP. These two main activities were constrained by serious uncertainty regarding the continuity of funding support for IPO operations in the first half of the year. In early June, thanks to the comprehensive efforts by the Dutch Science Foundation, Chair and IPO the funding situation was consolidated (see section 8). This new Dutch commitment allows secure continuation of operations during the whole transition period.

As mentioned earlier, in this first year of the LOICZ II core project, the organisational structure was revised and efforts concentrated on the development of the 5 new guiding themes that evolved out of the Future discussion and consultation process. However, many important activities established successfully under the old foci structure continued, sometimes with increased other times with slower momentum, but with many of them facing a hiatus in direct LOICZ funding. This does not reflect any disregard of the substantial contribution of the science produced or the contribution that the old LOICZ has for the future. It rather reflects the needs and priorities set by the SSC to establish LOICZ II as an enabling platform that supports the implementation of new and challenging interdisciplinary science. To achieve this LOICZ II will have to find ways to integrate, and thus continue, the further development of those efforts of the past that will help shape the future, provide tools and add value to LOICZ II.

**Implications for this Annual Report**
Therefore this Annual Report reviews the 2003 status and ongoing activities of the work under the LOICZ core projects and refers to the old Foci where appropriate. In addition, and underlining that this report is on transitional activities, it tries to include where possible a perspective on how these activities will influence and be linked into the new Themes. In meeting the challenges of LOICZ II, the success and effectiveness of the SSC and IPO will be measured against the successful integration and further development of scientific approaches and tools and networks that form the legacy from LOICZ I. Restructuring of the IPO and the SSC are expected to be pivotal to this, but also a monetary component is involved that may take the whole transition period, if not longer in some cases, to be settled to full satisfaction.

In general, those core projects that where originally organised under LOICZ Focus 1 and 4 operations were continuously coordinated, and future developments supported, by the teams of the ELOISE project, namely, but not exclusively, by the EuroCat team under the coordination of Wim Salomons, the GKSS, Germany, Jozef Pacyna, and Jan Vermaat and many others. In particular, during the Synthesis process their work received additional inputs from Bob Buddemeier, Dennis Swaney, Jim Syvitski and Peter Burbridge (again not exclusively). The human dimensions component benefited from growing inputs and vital exchanges with the joint LOICZ IHDP Science Plan scoping team (see section 2).

In those core projects that where originally organised under Focus 2 and 3 the fact that we have not only functional but even improved capabilities available is due to the continued advocacy and coordination by Steve Smith, and to Daphne Fautin's recognition and advocacy of the utility of LOICZ-derived databases and tools to the fields of biogeography and biodiversity studies. In addition to the ongoing participation of Dennis Swaney, we owe a great deal to the computer support staff of the Kansas Geological Survey, and to its Director, Dr. M. Lee Allison.

These and other colleagues provided this report with considerable material collated by Bob Buddemeier. The IPO and the "old" and new SSC members have consistently worked to keep the parts of the "old" and the "new" LOICZ connected.

The core project reports will be organized to provide:

- Background – a brief description of the primary products and their origins, along with brief reference to some of the most important coordinated products and projects;
- Status -- the present operational status and individual or institutional curatorial activity with regard to the major components;
- Developments – recent (mainly 2003 or later where needed) technical developments in the facilities, and also programmatic developments in terms of interest and support by other programs, projects, and institutions;
- Needs and opportunities – technical modifications, upgrades, or further developments that are essential or highly desirable to ensure continuation of the capabilities that exist and to expand their utility for present and potential new users;

## 3.2 LOICZ CORE PROJECTS (PHASE I AND BRIDGING INTO PHASE II)

LOICZ in general has as one of its primary goals the characterisation of the role of the coastal zone in material fluxes – in coastal estuaries and seas, and in terrestrial catchments and river basins. Recognising that the world coastal zone is complex, heterogeneous and largely unstudied, this functional globalisation is being carried out by up-scaling biogeochemical and human dimension data, and generalising from well-studied areas to similar but less well-known regions.

The LOICZ core projects address global issues either by production and testing of widely applicable models of change in the coastal zone, or providing wide geographic syntheses of information about coastal properties, coastal fluxes or coastal processes and their rates of change. Eight core projects were established in LOICZ I, a first new one was established in 2003 under LOICZ II (those marked with an asterisk were completed before 2003; related foci indicate directions of application of tools and/or results or information exchange between foci; see LOICZ's web-page www.loicz.org for further details).

| Title | Related Foci from Phase I |
|---|---|
| River Catchments and Basins – LOICZ-Basins | 1,2&4 |
| Coastal Typology Development | 2 (3) |
| Biogeochemical Budgets and Modelling | 3 |
| Continental Margins Task Team (CMTT) | 1&3 |
| Deltaic Processes and Management | 1,2&4 |
| ELOISE | 1 to 4 |
| Submarine Groundwater Discharge (LOICZ/SCOR) * | 1,2&3 |
| SARCS/WOTRO/LOICZ Southeast Asia Research * | 1,3&4 (2) |
| SCOR/LOICZ/IAPSO Working Group "Mechanisms of Sediment Retention in Estuaries" | (new LOICZ, theme 4 and partly 2 and 3) |

### 3.2.1 River Catchments and Basins - the LOICZ-Basins core project

The work conducted under this core project originated in Focus 1 of the first phase of LOICZ: *Effects of changes in external forcing or boundary conditions on coastal fluxes* (Focus Leader: Prof. Wim Salomons), although there are visible links with the other foci. Focus 1 emphasized the impact of human society on horizontal transport of materials to the coast. Pathways under consideration comprise surface run-off as well as groundwater.

In the LOICZ-Basins core project the coastal impact of these mass transports is being assessed, in particular their change under natural and human forcing, and aims to provide feasible management options within a context of analysis of success and failure of past regulatory measures. The scale applied is the catchment – coast water continuum scale.

The main effort in 2003 has been consolidating the flurry of activities of the previous years of LOICZ-Basins. The regional assessment and synthesis projects conducted in 2001, and continued in 2002, have been finalised and concluding findings distilled and processed to feed into the related LOICZ synthesis chapters (see section 4.5). An extensive desk study on the Russian Arctic Basins was commissioned and developed to a second revised draft. The study focuses on the major rivers draining to the Russian Arctic by applying the LOICZ Basins approach. It complements the new regional Arctic Coastal Dynamics project, ACD, (see section 3.3) by providing the catchment-based view on coastal change. Most recent data have been included in the analysis. Publication as a LOICZ R&S report is expected in 2004. The new regional project (AfriCat – see section 3.3), which covers four contrasting catchment-coastal sea studies on the African continent focuses on the issue of damming. Beyond its pilot sites it engages with other ongoing and related activites such as the multinational Catchment2Coast (EU/INCO) investigating resources in Maputo bay and their dependency on catchment change. The EuroCat and daNUbs projects have almost reached a sunset clause and LOICZ has been involved actively in fostering exchange, review and synthesis. Both are leading in the development and application of indicators, and scenarios. At the end of 2003 these efforts had accumulated either in first draft final reports or beginning synthesis. In the following year/s both research projects will be further influencing the development and design of new scenario oriented research and LOICZ policy.

The following chapters, based on a compilation provided mainly by Wim Salomons, highlight accomplishments of the core project under this focus with a view on implications for LOICZ II highlighted.

**Background**

Within LOICZ-Basins a standardised framework of analysis was developed to assess the impact of land-based sources (and in particular catchments) on coastal systems (*Kremer et.al., 2002 methods in R&S 21*). The water continuum scale applied here means that in addition to economic activities (e.g., agriculture, fisheries, urban development, industry, transport, tourism), morphological changes (e.g., damming) are taken into account as driver/pressure settings affecting the fluxes. Though global in focus the Basins assessment has continued with a regional approach based on the DPSIR framework as a tool for integrating human dimensions, biogeochemical state changes and environmental impact assessment at various spatial scales. Researchers involved also tried to develop a better understanding of how key indicator parameters influence critical thresholds of environmental functioning and health. This effort ultimately aims to fit into the critical load concept (as has been done for atmospheric pollution abatement) for a cost-benefit analysis of management options. Scenario-building was an integral part of this analysis. Reports and updates on the project status are available via: http://w3g.gkss.de/projects/loicz_basins/. In particular the parameters assessed are:

- material flow of water, sediments, nutrients and priority substances such as contaminants (past, current and future trends);
- socio-economic drivers which have changed or will change the material flows;
- indicators for the impact on coastal zone functioning; and to derive from them
- "critical load" estimates of nutrients, contaminants, sediment (water fluxes) affecting system stability and functioning of the coastal zone.

**Status 2003+**
To date (end 2003) close to 100 catchment-coastal sea systems have been analysed through workshops and desktop studies. In addition, the individual assessments were scaled up to coherent continental regions. The steps taken are:

- to set up a list of coastal change issues and related drivers in the catchment.
- to characterise and rank the various issues of change based on either qualitative information (i.e. expert judgement) or quantitative data. This step includes identification of critical load and threshold information for system functioning where available. Since each continent or sub-continent has its own team of experts, it is only valid to compare the internal regional impact assessments. Comparison across continents must be treated with caution although in each case the reasoning behind the assessment is backed up with literature data whenever available.

Large catchments addressed within a global LOICZ synthesising effort (e.g., Amazon, Nile, Yangtze, Orinoco) were part of the evaluation. However, from the perspective of coastal change, the major influence from land-based flows is more often generated in small to medium catchments with high levels of socio-economic activity. Thus, small and medium catchments were a priority for the global LOICZ-Basins assessment. They dominate the global coastal zone and in Africa, for example, they characterise extensive parts of monsoon-driven runoff to the Indian Ocean. In island-dominated regions such as the South Pacific or the Caribbean frequently a whole island is a catchment affecting the coastal zone.

Results from the continental up-scaling have been visualised in standardized tables providing a ranking of main driver/pressure – coastal state change scenarios, trend expectations, hard data or qualitative estimated on critical loads and distances to critical thresholds. Findings have proven to be strongly influenced by local conditions; however a number of major drivers and pressures are common, albeit with a different ranking.

**Gaps needs and Opportunities – Implications for the "New" LOICZ**
LOICZ-Basins has shown that humans play a powerful role in altering hydrology and material fluxes and fate and transformation in the coastal realm (*Meybeck 2003, 2004, Salomons 2004, Syvitski et al 2004, Vermaat et al 2004 see in EuroCat Synthesis*). This influence has greatly changed in rate and scale through the past two centuries, but still a thorough understanding of the causal interlinkage between these drivers/pressures and the coastal state changes remain a major challenge. This challenge has to be addressed at different scales:

1. The global scale: The common nature of many drivers/pressures such as intensification of agriculture, expansion of built environments and effects of impoundments requires analysis on a global scale (*Meybeck 2004 pdf-Ldrive*). Coastal signals, however, frequently reflect the complex interplay of these land-based processes with additional climate change affecting hydrology of catchments as well. It is expected that low-lying areas like deltas and large estuaries will be particularly sensitive. A global assessment focusing on past and future changes in coastal morphology by taking the multitude of changes in the catchments is needed. A major challenge, which has to be addressed, is the temporal delay in changes at the catchment level and their impact at the coast.

2. The regional scale: Supporting the findings of the LOICZ global investigation on estuarine metabolism (see section 3.2.2) LOICZ-Basins has proven that science must look outside the narrow confines of artificial coastal zone boundaries and take a "source-to-sink" approach. It is seen that the challenge of maintaining the continuity of coastal goods and services for human society in the context of river catchment-coastal sea interaction is predominantly regional in scale. Consequently the typically "regional scale science" is challenged to be relevant for the global earth system understanding (up-scaling), where at the same time it needs to inform local or sub-regional management.

3. National/local or management scale: Major gaps characterize our scientific comprehension of the implications of hydrological, and land-use induced impacts on the water cascade – in particular the spatial and temporal scales. Such a spatial scaling issue, in relation to biodiversity, is the buffering capacity of coastal systems including effects on biomes and resources. Temporal scaling issues arise form soil chemistry, catchments size etc. affecting the delay between coastal signals and catchment-based causes. Both aspects inherit a substantial challenge to science that aims to inform management in the coastal zones and underline that it cannot be decoupled from management in the catchment.

In summary
LOICZ Basins, similarly to the biogeochemical assessment, has demonstrated the importance of small and medium size catchments in influencing coastal processes. It calls for an integrated approach combining the expertise of natural and social sciences, which is critical especially in the fields of integrated assessment, transition management, valuations, cost-benefit and multi-criteria analysis, mediation, and policy and conflict resolution. The DPSIR approach and assessment framework needs to be extended to enable advanced modeling of the coupled human/natural systems and to disentangle the cause–effect relationships of those impacts and human activities which are strictly coast or river basin-oriented (regional) from those derived from much wider external pressures on the river-coast system, such as climate change, population pressure and the global economy.

LOICZ II needs to;

- identify the critical choke and switch points of system functioning and where intervention could yield the most beneficial effect for human interaction in the coastal zone. This is in appreciation of the fact that while most of the benefits of appropriate, science-informed management will be gained at the coast, many of the costs will be incurred within the river basin.
- identify and acknowledge those management units (and their key environmental system functions) where intervention (response) can best be implemented and to involve from the onset the users representing the management units (e.g., through initial stakeholder inventories).

An earlier regional study showcasing initial steps of integrating natural and social sciences, in order to link and quantify catchment based sectoral economic activities with coastal metabolism and change in South East Asia (**S**ARCS **WO**TRO **L**OICZ, SWOL project, (see http://www.loicz.org) has yielded initial simple models and emphasised scaling mismatches and potential for new approaches (*McManus et al., 2001, R&S 17*). This is pointing a way forward as do the wide ranging approaches taken by the EuroCat, daNUbs and Catchment2Coast Programmes of the EU (see http://www.iia-cnr.unical.it/EUROCAT/project.htm, http://danubs.tuwien.ac.at and http://www.catchment2coast.com. These ongoing European and African regional studies (e.g., under ELOISE and INCO) have shown that such an evaluation of societal and institutional dimensions of change, along with their ramifications mentioned above, can be employed to elaborate future scenarios (*Ledoux et al 2004*). This will include identifying and considering the different perspectives of the various stakeholder groups on coastal change subject to the boundaries of the domain in which they are mainly operating (*Meybeck and Vogler in prep see EuroCat syntehsis.)*

Approaches ahead and needs: There is no doubt that meeting the challenges mentioned above will be constrained by the scarcity of data and information and, in part, a lack of disciplinary capacity in particular in the socio economic field that has become obvious in various regional studies. Improving the mostly qualitative expert typologies that resulted form LOICZ-Basins can only be supported in data rich areas.

In principle quantification of the findings (**New LOICZ Theme 2: Implications of global change and land and sea use on coastal development** and **3**: **Anthropogenic influences on river basin and coastal zone interactions**), prediction and risk/vulnerability analysis (**Theme 1: Vulnerability of Coastal Systems and Hazards to Human Society**) at the catchment basin scale and on full regional and global scales, remain major challenges for LOICZ.

Besides fostering the regional networks and enabling better data access, one way to address this issue is to continuously build further the typology database and analytical tools and to include land-based information, e.g., through engaging with the IHDP for global scale data on social impact of global change. The status of drivers and state changes should be revisited and the main threats to man and the environment described in more detail by applying an advanced typology tool (*McLaughlin et al., 2003 EuroCat Synthesis*) (see also section 3.2.2 for a detailed consideration of options and opportunities). This will help the evolving LOICZ core activities to become a reference mechanism providing the science and methodologies to conceptionalize and classify the global coastal zone.

### 3.2.2 Coastal Typology Development (incl. supporting databases and software) and Biogeochemical Budgets and Modelling

Activities conducted in these core projects were originally associated with LOICZ Foci 2 and 3, i.e. Coastal biomorphology and global change (Leader: Dr Robert W. Buddemeier supported by A/Prof. N. Harvey (sea-level issues) and Drs G. Perillo & J. Syvitski (sediment studies)) and Carbon flux and trace gas emissions (Leader: Prof. Stephen V. Smith, supported by Prof. Fred Wulff and Dennis Swaney (synthesis & web site development)).

Focus 2 addressed the role of ecosystems in determining coastal morphodynamics under varying environmental conditions. It includes coastal biomorphological responses of systems such as coral reefs, mangroves and sea grasses to human activities, to changing environments, sea level change, and groundwater implications for coastal habitats, sedimentary processes, and the development of classification systems (typologies). A key issue is how to deal with spatial and temporal scales of change in the coastal zone.

The emphasis of Focus 3 is on the development of a suite of global sites describing the biogeochemical budgets for carbon, nitrogen and phosphorus fluxes and processes in estuaries and coastal seas. This follows an approach developed by LOICZ during the early phase of the project as a way to deal with limited data at sites within a heterogeneous area of the globe (LOICZ R&S No. 5, 1996). A key goal is determining the relative autotrophy and heterotrophy of the coastal zone i.e., is the coastal zone a net source or sink for CO2? A watching brief is maintained on the development of knowledge about the net vertical flux estimations for trace gases in the coastal zone in particular in collaborative work and exchange with SOLAS and IMBER.

Major activities which started under these Foci, which continued into 2003 or were initiated, include the synthesis of sediment fluxes through riverine systems to the global coastal zone and their change, which resulted in a comprehensive special issue (Syvitski et al. 2003). Sediment dynamics in estuaries are the key subject of the newly established working group (WG 122) jointly sponsored by SCOR and LOICZ with support by IAPSO (see section 3.3). The LOICZ project on the continental shelf pump based at NIOZ employed *in situ* measurements of CO2 air sea exchange and resulted in a comprehensive system evaluation and up-scaling paper submitted to Science (Thomas et al – accepted in 2004). In addition to these examples for activities/publications, the “ex” Focus 3 group has been working on its contribution to the LOICZ synthesis book and to the CMTT synthesis book (see below).

In more general terms in the following chapters, based on a compilation provided mainly by Bob Buddemeier, accomplishments of the core projects under these foci with a view on data, models, and up-scaling platforms are reviewed and implications for LOICZ II are highlighted.

**Background:**
There are five inter-related and largely interoperable components of the LOICZ I data and analysis system:

1. A global environmental database, with terrestrial, marine, coastal, atmospheric, human-dimension, geomorphic, and river-basin variables;
2. A site for biogeochemical budgets information, inventory, and instructions;
3. A database of biogeochemical budget variables (biogeochemical and site environmental);
4. Analytical and data management tools, most notably the geospatial clustering tools (WebLOICZView, WLV, and DISCO); and
5. The internet front ends, providing user access to the system components and the integrated aspects.

These systems were developed as part of an overall strategy of assessing coastal zone function by assembling consistently characterized functional data (in LOICZ I, primarily biogeochemical flux and budget information) and information on the environmental context (the drivers, both natural and anthropogenic) that would permit understanding, classifying, and ultimately upscaling the functional information.

A second major overall component of the strategy was to operate on a distributed and inclusive basis, facilitating participation by the widest possible range of coastal scientists. For this purpose, internet access and a range of standardized but powerful tools (particularly for budget preparation and data visualization and analysis) were provided, and GEF-funded workshops were used to recruit and train participants and to beta-test and improve the system.

**Status 2003+:**
Although until the end of 2003 almost 12 months had passed since the end of formal support by the LOICZ organizational structure, all of the components still exist, most are still fully operational, and there have been advances and further developments in some areas. This is due to three factors: (1) the commitment and dedication of the team of people (and to a significant degree, some of the institutions) involved in the initial development; (2) recognition by others, both inside and outside of the LOICZ community, of the broader potential of these facilities and tools; and (3) some success in acquiring funding or in-kind support for the operation for non-LOICZ but related applications.

The Biogeochemical Budgets website is still functional, operated out of the University of Stockholm (http://data.ecology.su.se/MNODE) and with basic maintenance on a volunteer, time-available basis. This is the component that is probably in the most precarious position in terms of institutional support.

Late 2003 the geospatial clustering tools (WLV: www.palantir.swarthmore.edu/loicz), its intended successor, DISCO (narya.engin.swarthmore.edu/disco), and their application-specific internet front-ends are served and maintained at Swarthmore College by the developer, Bruce Maxwell (also largely on a volunteer basis, augmented by external support when it is possible). WLV is in maintenance-only status, to be kept available for use as long as it is operationally feasible. All new development will focus on the DISCO platform, developed with NSF support as a standards-compliant extension of the WLV capabilities (see Developments section below).

The Environmental and Biogeochemical Budgets databases are maintained and served at the Kansas Geological Survey (www.kgs.ku.edu/Hexacoral: Environmental database link), as are

the internet front ends and some on-line tools for data management. The database is directly linked to the WLV application at Swarthmore; similar interoperability can be established with DISCO. The budget data are accessible, but essentially archived; the other components have had active maintenance and some upgrades and modifications. Support from this has been by a complex mixture of volunteer efforts, institutional commitments and spinoff applications (KGS has a major initiative in the area of biogeoinformatics: www.kgs.ku.edu/Geoinfo2), and support from funded projects that used part of, or extensions of, the capabilities (see Developments section below).

**Developments:**
A variety of LOICZ-relevant modifications and upgrades of the facilities have been accomplished outside the LOICZ support framework, and especially during the post-LOICZ-I period of 2003+. Many of these have been the result of funding from other sources and for other (related) purposes, and in many ways these broader interests and applications are as important as the specific technical applications for which they are (or will be) responsible.

*Hexacoral/KGS*: Much of the web-based environmental data system at KGS is the result of developments funded by the NSF-sponsored project "Biogeography of the Hexacorallia" (Hexacoral) project. That project linked a sophisticated taxonomic and biogeographic database system to the environmental database and tools, and established interoperability with other databases and portal systems. Related developments include:

- Development of KGSMapper, a dynamic environmental mapping tool and associated data input and selection capabilities (see a demonstration site for biological applications at drysdale.kgs.ku.edu/website/Specimen_Mapper/mxmapitmod.cfm). This capability extracts values of selected environmental parameters for locations selected or entered by the user, and plots maps of the 1 and 2 std. dev contours and total range defined by the selection of points and parameters. Although presently used at a global scale for biogeographic ranges, it is scale- and application-independent, and will function with any environmental database and input of points. It is one of the distributed services linked to queries of member databases by the Ocean Biogeographic Information System (OBIS) portal (www.iobis.org), of which Hexacoral is a part, and is widely used. It is also used bilaterally by two OBIS providers, FishBase (www.fishbase.org) and CephBase (www.cephbase.org).

- The OBIS federation has also promoted development of XML schemas and the use of standard query tools for interoperability; Hexacoral is fully compliant, and now serves data through both the NVODS (OpenDap) and DiGIR protocols.

- With supplemental NSF funding, Hexacoral has developed a number of additional modules that have wide potential applications. Specific examples include a common names database built from community on-line contributions, a gazetteer look-up function, and an expedition database structure that can integrate station- or site-specific records with the larger biological and environmental databases. Expanded options for geographic region selection (easier and more flexible user input, as well as standard definitions such as EEZs, Longhurst biogeographic regions, and large Marine Ecosystems) have been implemented for the biological data and are being adapted for the environmental data selection front end (URLs to view development prototypes are available on request).

- Small additional grants and contracts from Species-2000, the US Fish and Wildlife Service, and the National Biodiversity Information Initiative (NBII) of the USGS have promoted additional developments; the latter two are focused on specific Pacific islands and reef systems, and with the 'expedition' database module, have stimulated trials of approaches to nested higher resolution geographic databases that can augment the global

half-degree environmental database (see also discussion below under bgc budgets). A 500-m database of much of the Australian CZ is being constructed as a prototype.

*Geospatial clustering/analysis*: The WLV tool was the 'production model' analytical tool throughout LOICZ-I, but in 2003, based on experiences with LOICZ I applications and workshops, the development of the follow up package called DISCO was started. Work was accelerated by an NSF exploratory research grant.

- A DISCO working prototype is now available for use (with an easily acquired user password) at: narya.engin.swarthmore.edu/disco; a background paper describing concept and design is also accessible there. DISCO includes two major features not found in WLV: a fuzzy clustering routine (and a related cluster stability output), and a time-series clustering capability. Most, but not yet all, WLV functions have been carried over into this first version of DISCO.

- The conceptual basis and much of the work plan for version 2 of DISCO have already been developed. This resulted from a workshops sponsored by the NOAA Estuarine Eutrophication Program (Suzanne Bricker, director), which has adopted the LOICZ typology approach to classifying US estuaries for assessment and management. Workshops involving both a user community and a smaller team (Bricker, Smith, Maxwell, Buddemeier and other NOAA colleagues) have identified and prioritized data needs (see below) and desirable modifications and extensions of DISCO.

*Biogeochemical fluxes*: There have been advances in both methodology and understanding of the biogeochemical flux/budget issues, primarily through initiatives led by Steve Smith. These have not yet been translated into changes in database design or content, but the needs and potentials have become much clearer over the past years.

- The major impediment (with high relevance to the "New" LOICZ) to more effectively classifying and up-scaling CZ biogeochemistry (and other features) has been reliance on the UNH half-degree river basin database. Although global in scope, it does not adequately identify or describe the small river basins (ranging in drainage area from <<1 to a few half-degree cells) that dominate most of the length of the global coastline. Smith and colleagues have shown that GIS-defined basins based on globally available 1-km elevation datasets can be used effectively to analyze basin nutrient yields and coastal loads (Smith et al 2003; other papers submitted and in preparation). Since the Hexacoral/LOICZ environmental database is already based on many variables with resolutions finer than half degree (e.g., coastline, elevation, depth, population, land use/landcover), and since half-degree climatologies can be satisfactorily sub-sampled for many hydrologic and atmospheric variables, a second-generation higher-resolution set of regional databases (see also final bullet under Hexacoral/KGS above) can be generated on the basis of available datasets.

- As another component of both ongoing analysis and the NOAA Estuarine Eutrophication effort described above, Smith has identified and assembled both US datasets of additional eutrophication-related variables, and a much larger inventory of basin load and yield data than was represented in the Bioscience paper (Smith et al. 2003) cited above. These provide potential content for future higher resolution regional and/or global databases, and the data themselves; the experience gained in collecting and applying them also provide additional insights into needs, potentials, and system design.

**Needs and opportunities - implications for the "New" LOICZ:**
*Needs*: Viewed from the standpoint of future LOICZ use of and participation in the data, information, and analysis system, there are three classes of needs.

1. Formal programmatic commitment to the individuals and institutions involved (through MoU, and/or LOICZ Node for example) incl. a steering component from within LOICZ. It is pivotal to identify intentions for duration and nature of support and interaction, desired and optional directions and activities (and products, if specific funding is committed), and technical and administrative responsibilities. At least token funding needs to follow or accompany this commitment underlining institutional credibility. This step is critical to minimize the potential for loss of key participants and for even more rapid divergence of system developments from the objectives and interests of LOICZ.

2. Compensatory maintenance. Sustained routine maintenance is necessary with facilities as complex as this one; because many parts of the system have received little or no attention during the initial LOICZ transition in 2003 and this is likely the case in 2004 as well. The amount of "renewal" work to be done before maintenance support can become "routine" is substantial. Activities in this category may include (though not exhaustive):

- All website links, contents, and structures reviewed and updated as necessary.
- If the Biogeochemical Budgets website is to be served from a location other than U. Stockholm, it needs to be installed and tested at its new home (e.g., a LOICZ Regional Thematic Node?).
- Database contents must be reviewed and updated with more recent or better datasets that have become available over the past two years, and the metadata files must be completed.
- Front-end upgrades planned or in progress need to be completed (e.g.: new locations selection tools for the environmental data, expanded capabilities for combining user-supplied data with database data selections, links to mapping and calculation tools).
- Improved user-friendliness in the DISCO pages (menus, page design, more download options for results, use-controlled file names, etc.)

3. Development activities. Although not immediately essential, these major projects are critical to the long-term utility and applicability of the system. Some development needs can be specified now; others will inevitably grow out the developing LOICZ activities and objectives.

- Design and implementation of high-resolution regional database systems, served with the same tools and front-ends, and seamlessly interoperable with the global database and with each other (this should include development of km-scale basin coverage for the world coastal zone).
- Review and redesign of the biogeochemical budgets database to accommodate the additional datasets and variables being developed, to facilitate further additions by the user community, and to mesh with the high-resolution environmental databases.
- Development of DISCO v. 2. In addition to the compensatory maintenance mentioned above, we need to add several capabilities currently operational only in WLV, provide additional data manipulation capabilities within the application itself or a linked module, improve the time-series analysis front-end and capabilities, and automate the process of searching for optimal combinations of variables to classify features according to selected criteria.
- Further developments in support of LOICZ objectives. This report is not the place to propose detailed road maps, but it is worth noting that although the past and present system has been developed with the topics of **Themes 3** (**Anthropogenic influences on river basin and coastal zone interactions**) and **4** (**Fate and transformation of materials in coastal and shelf waters**) as primary targets, the expanded capabilities and

higher-resolution databases will make it readily adaptable to comparable support of **Themes 1** (**Vulnerability of Coastal Systems and Hazards to Human Society**) and **2** (**Implications of global change and land and sea use on coastal development**). In fact, spin-off applications have already been applied to other socioeconomic and social anthropological problems (see below). Once the component themes are supported with comparable data and tools, the system as a whole can be used for their integration into the human dimensions issues of **theme 5** (**Towards coastal system sustainability by managing land-ocean interactions**).

As a subset of LOICZ development opportunities, LOICZ may, for instance, think of improving/evaluating the budgeting procedures. This can include, e.g., bringing in some simple generic modeling analysis and to deal with small systems in LOICZ-like budgets. The LaguNet network which became highly active in 2003 in Italy has built a Java-based budget calculator that essentially builds on what CABARET has done. That needs to be checked for accuracy, and probably expanded in versatility. LaguNet is planning to broaden its activities to the wider Mediterranean.

*Opportunities*: The hiatus in direct LOICZ support associated with the end of phase I has, along with the inevitable problems, had some real long-term benefits in that it has both forced and allowed the individuals to develop other applications, support, and ideas. These now represent a much-expanded resource base that can be brought to bear on the increasingly complex objectives of the "New" LOICZ. A brief (incomplete) summary by Bob Buddemeier:

- Connections – both scientific and in terms of interoperable data sources - with the larger ocean-data and biological communities via the OBIS structure. The extensive association between biogeographic and our environmental databases is rapidly converging on the ecosystem assessment capability need for both, economic and hazards evaluation in the CZ. One particular example is the close association with Fishbase (www.fishbase.org), which is fisheries-oriented and actively used by research and management communities.
- Technical experience and infrastructure. KGS has a major program in geoinformatics (www.kgs.ku.edu/Geoinfo2/index.html), of which the Hexacoral/LOICZ efforts have been a major component in the environmental and biological areas. As does Hexacoral through the OBIS connections, the other KGS initiatives strongly emphasize development of dynamically interoperable distributed systems, on-line tools for user support, and GIS-based visualization. The association offers not only technical support, but also cutting-edge development capacity.
- Experience and contacts with socioeconomic and human dimension applications. KGS has adapted the environmental database and front-end to a square-mile grid and terrestrial hydrologic and geologic data, and has used that in conjunction with WLV and DISCO to support water management classifications of the Ogallala aquifer (*Wilson, B.B., D.P. Young, and R..W. Buddemeier 2002. Exploring relationships between water-table elevations, reported water use, and aquifer lifetime as parameters for consideration in aquifer subunit delineations. KGS-OFR 2002-25D, Kansas Geological Survey, Lawrence, KS, 28 pp* (www.kgs.ku.edu/HighPlains/OHP/2002_25D.pdf). Bruce Maxwell and colleagues have applied the clustering tools to research into geographic problems in social anthropology (*B. A. Maxwell, F. L. Pryor, C. A. Smith 2002. Cluster Analysis in Cross-Cultural Research, World Cultures, 13(1): 22-38).*
- Potentially synergistic financial support. A variety of proposals has been and will be written for support of activities involving further use and development of aspects of the system. Although none will directly address all of the LOICZ needs and objectives, there is the potential for considerable overlap in the system maintenance and some development areas.

Costs, management and time frame

A mid-range realistic planning estimate for a five year time frame might be (assuming a reduced overhead cost and some external support) ~100K/year base cost plus an additional 300K total divided over years 1-3. A possible time-line is laid out above; obviously this depends on the availability of funding as a function of time.

Long-term support issues: Under LOICZ-I, the possibility of transferring some or all of the data functions and capabilities to IOC or some other supra-national entity had been discussed. This is not foreclosed by the above suggestions of intermediate-term KGS/distributed support, but the transfer process itself will entail very substantial costs on both sides of the transaction if full capabilities are to be maintained. The role the new Regional/Thematic IPO Nodes could play in this context may be reviewed.

### 3.2.3 Economic and social impacts of global change in coastal systems

This focus under leadership of Prof. R. Costanza had no associated individual core project but is reflected in various core activities of the other foci (see 3.2.1 and 3.2.2) and influenced the synthesis as well as the SPIS development. In general the original focus addressed the two human dimensions in the coastal zone, looking at the

a) co-evolution of coastal systems under different scenarios of global change (essentially the impacts of humans) and

b) the effects of changes in coastal systems on social and economic activities.

The first element aimed to link natural and social scientists in researching key coastal issues to describe and model socio-economic pressures driving coastal changes in the use of coastal space and how this influences material fluxes and ecosystems. It has been shown above how this element is being picked up in the core activities and future themes (see also section 5.1).

The second element was aimed to develop tools and measures for producing regional and global forecasts of the effects of coastal changes on the human dimension, particularly through coupling of natural science and economic models. This work continues and involves the building of a database on economic valuation and cost-benefit approaches, within a context of community and wider stakeholder evaluations, in order to assess the vulnerability of coastal systems and human populations to global changes (reflecting in particular also in the new **Theme 1: Vulnerability of Coastal Systems and Hazards to Human Society**).

**Status 2003+**

In 2003 a key specific initiative directed to assessment and evaluation of the economic value of biogeochemical changes in the coastal zone continued through work at the University of Maryland. In this LOICZ study, a framework for the assessment and valuation of goods and services provided by coastal systems was developed and a first draft manuscript provided at the 14$^{th}$ SSC. It includes a typological approach capturing the functional diversity for classifying and valuing ecosystem services, emphasising that no single ecological or economic methodology can deliver the total value of these complex systems. Based on existing information and case studies the project demonstrates the process of ecosystem service valuation. Conclusions on coastal system values and implications for the advancement of coastal management are expected to be published in 2004: (Wilson, Matthew A., Robert Costanza, Roelof Boumans, Shuang Liu. 2004. Integrated Assessment and Valuation of Ecosystem Goods and Services Provided by Coastal Systems. pp. 1- 28. "The Intertidal Ecosystem", Wilson J.G. (ed.), Royal Irish Academy, Dublin. (in press))

Besides the continuation of this study, intensive exchange with the socio-economic and human dimensions science community and related LOICZ projects such as DINAS-Coast have influenced the design and structure of the draft LOICZ II SPIS. This includes vital discussions leading to a reorganisation of the Themes putting Vulnerability and Hazard issues upfront in the sequence and ultimately leading LOICZ II science into the Sustainability and

Management issue. Scientific papers in this field have to a large extent dealt with scenario simulation and how best to use science to inform different world views of development on different scales (see section 7).

### 3.2.4 CMTT

**Carbon and Nutrient Dynamics at Oceanic Margins, CMTT synthesis in progress**

To evaluate the present biogeochemical regimes, nutrient fluxes, and sources and sinks of $CO_2$ in the coastal zone, the Joint Global Ocean Flux Study (JGOFS) and the Land-Ocean Interactions in the Coastal Zone (LOICZ) originally formed a joint JGOFS-LOICZ Continental Margins Task Team (CMTT). In recognition that there was only rather limited knowledge about the dynamics of carbon, especially $CO_2$ gas exchange at the air-sea interface along the continental-ocean boundary the task team aimed to shed some light on the role of the World's oceans as major sinks and sources of carbon dioxide ($CO_2$) to the atmosphere.

During its work, which received additional support from the Intergovernmental Oceanographic Commission (IOC), a new perspective emerged that indicated global ocean margins are most likely a $CO_2$ sink and not a major source of $CO_2$ to the atmosphere as once thought. Following a global synthesis workshop the group ultimately outlined a book for the IGBP Book Series on our present knowledge of continental margins, tentatively titled *Carbon and nutrient fluxes in continental margins: a global synthesis*.

The editors Kon-Kee Liu, Larry Atkinson, Renato Quiñones and Liana Talaue-McManus will describe the group's synthesis and modeling approach. Where ocean observations and modeling have produced important findings, it extends the horizontal scales of biogeochemical flux box-models and budgets of carbon and major nutrients in coastal zones to the open ocean. In the selected geographical regions, a group of co-authors will describe concisely the dominant features, the best estimates of carbon and nutrient fluxes and their uncertainties. The book will also address cross-cutting issues of exchanges across land and sea, air and sea, water and sediment and margins and open ocean boundaries, and finally discuss arising issues, new approaches, global views and future prospects. Publication by Springer Verlag of this extensive synthesis effort is expected in 2004 or 2005.

### 3.2.5 Deltaic Processes and Management

Deltas are the result of strong interactions with rivers and the sea, with riverine influence generally dominant over marine forces. Due to the growing economic interests and increasing population in the world's coastal zone, the vulnerability to pollution and natural hazards is increasing. Furthermore, the impacts of climate change and other external factors must be added to the already existing problems of coastal management.

In the past, measures were taken and constructions built for human use of delta resources and environments. Not all of these were successful; on the contrary, developments such as the armouring of the deltaic coastline, or isolation by dikes or levees of the rivers flowing into and through the delta have isolated fresh inputs and flooding into the delta's wetlands and estuaries. The isolation of rivers and distributaries from deltas and armouring delta shorelines are two of the more notable problems that have caused billions of dollars in losses to development and populations in the delta as well as in degradation and loss of delta resources and environments.

The Delta Core Project is conducted by both the Land-Ocean Interactions in the Coastal Zone Project (LOICZ) and the program of the Coastal Zone Management Centre (CZMC) in the Netherlands Ministry for Transport, Public Works and Water Management. The Project was originally accommodated in Focus 4 (Human Dimension) of the first phase of the LOICZ programme. The project aimed to contribute to the evaluation of integrated coastal zone

management practices in modified mega-deltas. This information has direct application to the activities of Netherlands' Coastal Zone Management Centre (see http://www.netcoast.nl). Key is to identify what can be learned from the experiences of development within deltas and their associated drainage basin, including the planning and management in order to determine how deltas can be sustainably developed. Information about the project and the world's 21 Modified Mega-Deltas is available on the Delta website, www.deltasnetwork.nl. Questions addressed include:

- What are - or will be - the most significant changes in modified mega-deltas during the next to ten years.
- How are the fluxes of nutrients and sediment in deltas altered by human interventions?
- What information is available about best management practices in deltas? Are they being evaluated? What can we learn from these practices?
- Which concepts and tools are available for the sustainable development of modified mega-deltas? Have they been applied, and if so, in what respect have they been effective?
- What research is needed for further elaboration on delta management practices?

In 2003, the revised draft report of the first international workshop on planning and management of the world's modified mega-deltas was sent to the IPO. It reflects the findings of the workshop, held from September 24-26, 2001 at the Coastal Zone Management Centre based at the National Institute for Coastal and Marine Management (RIKZ) of the Ministry of Transport, Public Works and Water Management in The Hague, the Netherlands and subsequent authors revisions. An action plan was proposed for developing and operating an international information exchange network. Other products include:

- a list of issues commonly involved in planning and management of modified mega-deltas,
- a comparative analyses between the deltas,
- improved data on the deltas derived from the questionnaires used,
- a recommendation to apply the ecosystem approach for planning and management, and
- a plea to investigate the role and importance of pulsing events (e.g., river-borne floods, flooding from ocean-borne storms) for a sustainable development of deltas was stressed.

Though the draft still needs some additional work to comply with publication standards the findings have proven to give guidance for future research in order to resolve the major issues that are common to the modified mega-deltas. They have nourished initial discussions for a targeted collaboration between LOICZ and the new ESSP joint Global Water Systems Project, GWSP. A final report is still planned and under consideration by SSC experts.

### 3.2.6 ELOISE

The ELOISE thematic cluster, which between 1996 and 2003 comprised a portfolio of 60 finished and ongoing multi-national and often trans-disciplinary projects, is the European Union's contribution to LOICZ. After 9 years of collaborative regional research, ELOISE supported by it recently established secretariat has made an effort to synthesize its findings and to highlight major directions towards future sustainability in the coastal zone. ELOISE stems originally from the Environment & Climate and the MAST (Marine Science and Technology) Research Programmes under the 4$^{th}$ EU RTD Framework Programme. Acting in concert with the Programme for International Co-operation (INCO) and the research programmes of the Member States it continued under the 5$^{th}$ Framework Programme.

In 2003, two major efforts where conducted in the realm of the synthesis and in response to the demand to develop a vision for a new role of ELOISE in the ERA. The first was the international Conference: "European Land Ocean Interaction Studies on the edge; taking stock of the ELOISE approach" held in Gdansk, Poland, 24-27 March. Some 250 international and, multidisciplinary scientists followed the invitation to the Technical University in this historical City and were challenged to distil the scientific findings from

ELOISE that can assist European decision making and management. It was reiterated that to accomplish this goal one would need to convert the rather fragmented and primarily natural science oriented, although high standard scientific outputs, into appropriate tools applicable for the multiple scales and institutional dimensions of coastal policy.

The most remarkable change, as compared to earlier ELOISE conferences, was a much more structured thinking that came across in most of the presentations and discussions. Likewise with LOICZ, the catchment – coast water continuum scale guided considerable parts of the scientific presentations covering biogeochemical and hydrological issues as well as institutional and people issues, including economic fluxes and valuation efforts. Goods and services of complex coastal systems, their interplay with conservation aspects and biodiversity were addressed and the conference concluded in a vital discussion on future perspectives of European Coastal Research and its relevance in the field of Global Change and the Earth System as a whole.

As a second effort, tailored to enhance the "Community Added Value" of the research findings and to further develop the synthesis, the ELOISE consortium and secretariat carried out three thematic workshops on:

1. Upscaling and demands at the European and global levels, (Profs. Carlo Heip and Peter Herman, NIOO-CEMO, 07-10 May 2003;)
2. Integration into European Policy: Environmental Impact Assessment, (Prof. Wim Salomons and Dr. Jan Vermaat, IVM-VU, 2-5 June)
3. Developing coastal futures for Europe, (Prof. Kerry Turner and Dr. Laure Ledoux, CSERGE, UEA, 2-5 June)

These workshops featured a mix of fundamental and applied science encapsulated in a harmonized and effective synthesizing and communication mechanism based on a "Dahlem Conference Approach". The goal is to apply a retrospective, current and future perspective to identify information needs, instruments and frameworks that enable the science community to inform the coastal management in Europe at all relevant scales. Findings of the workshops are currently being processed to enter a Springer book publication" Managing European coasts: past, present and future"; issues addressed will include (draft):

*Theme 1 'Implementation of the WFD for CZM across Europe*
*Theme 2 'Methodologies and analyses for supporting implementation of the WFD*
*Theme 3 'Institutional and capacity requirements for implementation of the WFD'*
*Theme 4 'Globalization and the European coast: climate change and economic development'*
*Theme 5 'Integrated assessment and future scenario's for the coast*
*Theme 6 'Applications of integrated assessment'*

Since this ELOISE development at the transition from the 6$^{th}$ to the 7$^{th}$ EU Framework Programme parallels the design of a future science plan and implementation strategy for the second phase of LOICZ a close collaboration between the ELOISE and wider LOICZ community is pursued. Further information about the conference, including abstracts and the ELOISE newsletter, can be found under http://www.nilu.no/projects/eloise or by contacting: Dr. Kevin Barrett, ELOISE Secretariat and Consortium., Centre for Ecological Economics, NILU, P.O. Box 100, 2027 KJELLER, Norway, Phone: +47 63898245 (direct), +47 63898000 (switch), Fax: +47 63898050, e-mail: kevin.barrett@nilu.no

### 3.2.7 SCOR/LOICZ Working Group 112, continued global assessment of submarine groundwater discharge and The New joint IAPSO/IAHS Commission "Groundwater-Seawater Interactions"

Groundwater-Seawater Interactions (GSI) in the coastal zone are receiving increased attention. The SCOR-LOICZ working group 112 with support from UNESCO IOC, IHP and IAEA addressed this issue by a variety of approaches including ongoing intercalibration experiments. The goal was to evaluate the best methodological approaches as well as to provide some further insight into the global relevance of submarine groundwater discharge for coastal metabolism. The group operated in three task oriented units addressing the following issues:

1. Calculation and modelling;
2. Measurement, sampling and experimental design;
3. Typology, integration and globalisation.

In 2003 findings of this WG were synthesised and are reflected in a comprehensive Bioscience Special Issue (Burnett et al, 2003 – see section 7).

Another outcome of the growing scientific attention has been the establishment of a "Joint IAPSO/IAHS (IUGG) Commission on Groundwater-Seawater Interactions" with representatives from the International Association for the Physical Sciences of the Ocean (IAPSO) and the International Association of Hydrological Sciences (IAHS) (http://www.iugg.org/iapso/grdwater_seawater02.html). The new Commission will follow up on the SCOR/LOICZ WG-112 and increase its activities with a broad scientific scope and fostering the improvement of a global expert network. It will provide a platform encouraging in particular participation of young scientists. It operates under the following terms of reference:

- To foster research concerning the flow of groundwater into the coastal zone;
- To participate in research on submarine groundwater discharge within developing countries;
- To engage in capacity building and training so research concerning groundwater discharge to the coastal zone.

The commission and LOICZ encourage interested scientists, in particular young experts from developing economies to get in touch and investigate options for collaboration. Colleagues attracted to follow this call should get in touch with Evgeny A. Kontar (IAPSO), kontar@ocean.ru, William C. Burnett (IAPSO) wburnett@mailer.fsu.edu or Makoto Taniguchi (IAHS) makoto@nara-edu.ac.jp.

### 3.2.8 SARCS-WOTRO-LOICZ (SWOL)

The SWOL project addressing the modeling and economic evaluation of land-based activities and related biogeochemical change in coastal areas in South East Asia finalised and published its Phase I report (McManus et al. 2001, LOICZ R&S No. 17). Though, irrespective of substantial effort, the researchers finally did not succeed in generating support for a second phase SWOL, approaches and experiences still substantially nourish the discussions about the new SPIS. Parts of the research and former co workers of the SWOL team have been able to continue comparable activities under the newly launched large scale South China Sea project (GEF).

### 3.2.9 SCOR/LOICZ/IAPSO Working Group 122, "Mechanisms of Sediment Retention in Estuaries"

The Scientific Committee for Ocean Research (SCOR) and LOICZ, with additional support of the International Association for the Physical Sciences of the Oceans (IAPSO), have joined forces and approved the formation of the new working group WG122 "Mechanisms of Sediment Retention in Estuaries". Funding will be provided during the years 2004-06. The objectives of the group will be to determine the current state and advance on the understanding of the amounts and mechanisms for sediment retention in different estuarine zones. It will compare river sediment load to the sediment fraction escaping into the coastal ocean, and identify the importance of the different underlying mechanisms. Deficiencies in available data and gaps in our understanding will be addressed to better inform estuarine management.

Under the chairmanship of Gerardo M. E. Perillo (Argentina, **perillo@criba.edu.ar**) and Björn Kjerfve (USA, **bjorn@msci.sc.edu**), WG 122 includes, as full members, James Syvitski (USA), Eric Wolanski (Australia), Maria Snoussi (Morocco), Yoshiko Saito (Japan), Carl L. Amos (United Kingdom), Susana B. Vinzon (Brazil), Morten Pejrup (Denmark), and Shu Gao (China). A number of corresponding members have also accepted to participate, including Pedro Depetris (Argentina), John Milliman (USA), Pedro Walfir M. Souza Filho (Brazil), Ray Cranston (Canada) and Bob Stallard (USA).

Scientifically the group will focus on the critical role the interaction between fresh and salt water plays in determining the dynamics of estuarine circulation and sediment transport. Sediment budgets will be derived considering riverine delivery into the coastal zone versus local effects of waves, tides, and storm induced coastal erosion and longshore transport. Equally important is to evaluate mechanisms and how much of the remaining sediment will be retained within (i) the tidal portion of the river, (ii) the estuary proper, (iii) adjacent tidal flats and wetlands, and (iv) deltas building tidal flats and wetlands, which otherwise would become totally inundated as a function of relative sea level rise. This has hardly ever been established along the total length of an estuary and explicitly for the different portions of the estuarine system from where tides are first measurable until the beginning of a detectable marine salinity gradient.

Also anthropogenic influences need to be considered. Sediment load is certainly controlled by more than 2 million dams that currently exist globally and by demographic and climatic change. These will further increase the demand for irrigation water, cause land clearing and deforestation, water and hydrocarbon extraction, sediment dredging and dredge material disposal, and artificial structures along river channels, within estuaries, and near estuarine mouths.

In conclusion the group will aime to answer a.o. the questions, what fraction of the river sediment load eventually enters the coastal ocean, and why this percentage varies so widely globally? The first meeting of WG 122 will take place in September 2004 in Faro, Portugal.

**Other Core Project activities** are reported in Workshops (Section 4) and elsewhere in this report.

## 3.3 LOICZ REGIONAL PROJECTS

Regional projects contribute to LOICZ global issues within a regional framework or have outstanding regional coverage and relevance. In 2003 five new regional projects (by SSC approval, marked with an asterisk) joined the twelve major regional projects listed so far. These projects, LaguNet, Land-Ocean Interactions in the Yellow River Delta and Bo-Hai Sea, Carbon cycles in the fluvial and oceanic systems if Southeast Asia, Catchment2Coast and ACD are introduced in detail below. In addition, and where applicable, the report also provides update information on the other ones. More detailed descriptions about most of them have been published earlier in various LOICZ newsletters.

| Title | Investigator | Location PI regional cover |
|---|---|---|
| River Catchment – Coast Interaction and management Studies of the Coastal zone estuary and waterway management, Co-operative Research Centre, CRC | Roger Shaw | Australia |
| DINAS - Coast | Richard Klein, Anne de la Vega Leinert | Germany/Europe/ Global |
| LOICZ/START/IOC – AfriCat – Pilot project | Russell Arthurton & regional PIs | Africa (Morocco, Senegal, Kenya, Tanzania) |
| Dutch LOICZ Project | various | Netherlands/ Europe |
| Land-ocean interactions in southern South America PARAT ** (finished late 90ies) | J-L Probst | European Union |
| Arctic Coastal Dynamics (ACD) * | Volker Rachold | Gemany/Circum Arctic – Internat. |
| Ecology of tropical coastal systems: mangrove dynamics and management: MADAM | Ulrich Saint-Paul | Germany |
| European catchment assessment: EuroCat | Wim Salomons | Germany/ Netherlands/ Europe |
| Integrated coastal zone management in Banten Bay, Indonesia | A. Nontji | Indonesia |
| LaguNet- The Italian Lagoon Observational Network * | P.Viaroli & G. Giordani | Italy |
| Land-Ocean Interactions in the Yellow River Delta and Bo-Hai Sea * | Makato Taniguchi | Japan/ P R of China |
| Studies for integrated coastal zone management | Maria Snoussi | Morocco |
| Carbon cycles in the fluvial and oceanic systems in Southeast Asia * | Chen-Tung Arthur Chen | Taiwan |
| Key processes of ocean flux in the East China Sea (POFLECS) | Dunxin Hu | P R of China |
| Land-ocean interactions in China seas and their impacts on coastal marine environments, ecosystems and living resources | Dunxin Hu | P R of China |
| Land-ocean interactions in the Russian Arctic (LOIRA) | A.P. Lisitzin | Russia |
| Catchment2Coast * | P. Monterio | South Africa/ Swaziland/ Mozambique |

### 3.3.1 Regional Activities

A number of regional assessments of changes in the coastal zone, namely on South Asian Estuaries, Italian Lagoons and Estuaries and the Russian Arctic river-coast interaction were fully or almost completed throughout the year. They have been either posted on the web (see http://www.dsa.unipr.it/lagunet/med03/) and/or reached the state of reviewed manuscripts ready for publishing either in the LOICZ R&S Series or as workshop reports in 2004. The information has attracted considerable attention from international agencies with interests in river catchment management, and in the case of LaguNet the EU Commission in particular. This has led to further opportunities for research support at national and regional levels.

### 3.3.2 New Regional Projects

#### 3.3.2.1 Arctic Coastal Dynamics (ACD)

ACD is a multi-disciplinary, multi-national project of the International Arctic Sciences Committee, IASC, and the International Permafrost Association (IPA). Its overall objective is to improve our understanding of circum-Arctic coastal dynamics as a function of environmental forcing, coastal geology and cryology and morphodynamic behaviour. The work aims, among others, to establish the rates and magnitudes of erosion and accumulation of Arctic coasts including the amount of sediments and organic carbon derived from coastal erosion, and long-term monitoring including local community-based observation. It further aims to develop empirical models to assess the sensitivity of Arctic coasts to environmental variability and human impacts.

The project consists of two interrelated components: (1) a series of coordinated, synthesis activities, and (2) focused research projects and long-term observations. A first detailed introduction of the project was provided in LOICZ Newsletter No. 29 (Dec. 2003). The ACD project can be embedded in the "New"LOICZ **theme 2** "**Implications of global change and land and sea use on coastal development**" and will also directly contribute to **theme 4 "Fate and transformation of materials in coastal and shelf waters"**.

The fourth IASC-sponsored ACD workshop was held in St. Petersburg, Russia, on November 10-13, 2003. Participants from Canada (7), Germany (7), Great Britain (2), the Netherlands (1), Norway (1), Russia (32), Ukraine (1) and the United States (8) attended. 63 papers dealing with regional and/or circum-Arctic coastal dynamics were presented. Five thematic working groups were identified: (1) GIS working group to develop of a circum-Arctic coastal GIS system, (2) coastal permafrost working group to discuss processes involved in the transition of onshore to offshore permafrost, (3) biogeochemistry working group with the focus on transport and fate of eroded material, (4) biodiversity working group to initiate planning of an Arctic Coastal Biodiversity research agenda, and (5) environmental data working group to discuss coastal dynamics as a function of environmental forcing. Detailed results can be found under http://www.awi-potsdam.de/www-pot/geo/acd/acd-ws2003.html.

The ACD secretariat is located at the Potsdam Branch of the **A**lfred **W**egener **I**nstitute (AWI), assisted by an International Steering Committee consisting of Feliks Are (St. Petersburg State University), Jerry Brown (International Permafrost Association, Woods Hole), Georgy Cherkashov (VNIIOkeangeologia, St. Petersburg), Mikhail Grigoriev (Permafrost Institute, Yakutsk), Hans-Wolfgang Hubberten (AWI, Potsdam), Johan Ludvig Sollid (Oslo University) and Steven Solomon (Geological Survey of Canada, Dartmouth).

ACD Project Leader is Volker Rachold Alfred Wegener Institute, Research Unit Potsdam, Telegrafenberg A43, 14473 Potsdam, Germany, vrachold@awi-potsdam.de, http://www.awi-potsdam.de/www-pot/geo/acd.html.

#### 3.3.2.2 LaguNet: The Italian Lagoon Observational Network

LaguNet is a scientific observational network studying coastal lagoon ecology, especially the fluxes of nutrients and other contaminants from catchments to the near coastal environment. The network has five major objectives.

1. To provide a forum for discussion and cooperation between researchers who are studying biogeochemical processes in lagoons, wetlands and salt-marshes at sites along the Italian coast.
2. To evaluate available information and present understanding of the biogeochemistry of carbon, nitrogen and phosphorous in transitional and coastal waters under the influence of catchment basins.
3. To discuss the feasibility of the application of the LOICZ Biogeochemical Model to such areas.
4. To promote an agreed common approach to studies of biogeochemical processes, typology, indicators of health and quality that can provide support to management or policy applications in these transitional ecosystems.
5. Consider the feasibility of developing one or more projects either in Italy or in Europe (with Mediterranean EU partners as well as eventually from Eastern Europe and North Africa).

The idea of a network of Italian researchers who are involved in the study of lagoons and coastal transitional ecosystems was developed by the authors during and after the LOICZ workshop *"Coastal and estuarine systems of the Mediterranean and Black Sea regions: carbon, nitrogen and phosphorous fluxes"* (Athens, 5-8$^{th}$ February 2001 – see LOICZ R&S No. 19, Dupra et al 2001). After a bottom-up process that led to a first agreement, LaguNet was inaugurated during a workshop held in Venice 14-15$^{th}$ April 2002.

LaguNet comprises 130 scientists and PhD students. Presently 24 coastal ecosystems are under investigation, where the biogeochemical Model of LOICZ has been applied for well-defined time period. In total 81 flux estimations have been undertaken considering a wide range of systems and different time periods. Since the second half of 2003 a review process is underway with the support from the original LOICZ biogeochemical budgeting core project aiming to publish the results as part of the R&S series in early 2004.

The PIs are P. Viaroli and G. Giordani, Dept. Environmental Sciences, University of Parma, Italy; J.M. Zaldivar and N. Murray, JRC-CCE, Ispra, Italy; http:\\www.dsa.unipr.it/lagunet.

#### 3.3.2.3 Land Ocean Interaction in the Yellow River and the Bohai Sea

Since the 1970ies the Yellow River often does not reach to the Bo-Hai Bay because of huge amounts of water used for irrigation in its upper and middle reaches. Water shortage results from increasing demands for industrial and drinking water and irrigation, and induces water pollution, drastic decreases in groundwater levels as well as nutrient transport to the Bo-Hai Sea. The recent crisis in the Yellow River basin, in particular at the mouth of Yellow River Delta, is complicated because it is masked by natural climate fluctuation and global warming. Anthropogenic pressures originating from change of land utilization and water management interact with these natural pressures.

The purposes of this study are; (1) to evaluate groundwater and river water discharges and their dissolved material transports into the Bo-Hai Sea, (2) to evaluate the effect of recent Yellow River cut-off due to changes in land utilization and water management on groundwater and Bo-Hai Sea, and then (3) to evaluate the interactions between Yellow River, groundwater and Bo-Hai Sea. This project is related to the "New"LOICZ **Theme 3** (**Anthropogenic influences on river basin and coastal zone interactions**) in particular quantification of the change of land utilization and water management and resulting changes in river and groundwater fluxes of materials.

Studies on land-ocean interaction in the Yellow River Delta and Bo-Hai Sea are planed from 2003 to 2006 though; (1) geophysical, geochemical and biological investigations in Bo-Hay Sea, (2) measurements of chemical and biological components of water in Yellow River, and (3) investigations of the groundwater in the Yellow River delta using CTD in boreholes, seepage meters, resistivity cables, and fiber thermo-radars. A feasibility study on groundwater dynamics in the Yellow River was made on August 2002.

The data generated will be used for the analyses of groundwater discharge (MODFLOW) and dissolved material discharge by groundwater (SUTRA). An ecological model fit to the Bo-Hai Sea will be established using the above data. After combining the data of this project with those on interaction between land and atmosphere in the Yellow River Basin, the model of river basin and human interaction including land use change will be developed.

PI: Prof. Dr Makoto Taniguchi, Phone Number: +81-742-27-9202 Fax Number:+81-742-27-9291 e-mail: makoto@nara-edu.ac.jp (duration 2003 – 2007).

#### 3.3.2.4 Carbon cycles in the fluvial and oceanic systems in Southeast Asia, CASA

Human intervention in the carbon cycle over the last two centuries has generated anthropogenic carbon fluxes that are comparable in magnitude to major natural fluxes in the global carbon cycle. During this period, river basin development, most notably from the construction of dams and irrigation systems, has had a profound impact on riverine inputs of freshwater and carbon to the oceans. On a global scale, approximately 40% of the freshwater and particulate matter entering the oceans is transported by the ten largest rivers, in the form of a buoyant plume on the open continental shelves. However, the number of dams higher than 15m has increased by a startling seven-fold since 1950, and within the next few decades more than 50% of total global river flow to the seas may be dammed or diverted. Given these facts, the export of carbon to the atmosphere and oceans from fluvial systems will most certainly be severely affected, a perturbation that must now be included in analyses of the global carbon cycle.

The National Science Council of China-Taipei has funded a total of ten projects, including five from Taiwan under the title Carbon Cycles in the Fluvial and Oceanic Systems of Southeast Asia and one each from Indonesia (Research on Chlorophyll-a and phytoplankton Abundance under Monsoon Variation in the South China Sea), Laos/Thailand (Organic Carbon and Carbonate Chemistry in Nam Theun Basin: A Baseline Study Before Dam Construction), Singapore (Sediment Transport to the South China Sea), Thailand/USA/Japan (Contribution of Carbon and Nutrient Species into SE Asia Waters via Submarine Groundwater Discharge) and Vietnam (Quantifying and Predicting Carbon Fluxes and Fishery Resources in Red River Basin, Vietnam).

PI: Chen-Tung Arthur Chen (Institute of Marine Geology and Chemistry, National Sun Yat-sen University, Kaohsiung 80424, Taiwan, R. O. C. Email: ctchen@mail.nsysu.edu.tw)
A total of 11 subprojects from Taiwan, Vietnam, Laos, Thailand (with co-PIs from Japan and USA), Singapore and Indonesia will be conducted (Aug, 2003 - July, 2005).

#### 3.3.2.5 Catchment2Coast linking coastal resources variability and river inputs in Africa

Catchment2Coast is an interdisciplinary, multi-institutional and transboundary modeling research project, designed to improve the scientific understanding of the linkages between river catchments and their associated coastal environments. Supported by EU-INCO it took off in October 2002.

The general objective of Catchment2Coast is to design, implement and validate a generic integrated planning and management support system for linked catchment–coast systems in southern Africa, which can also be implemented beyond the region. It also aims to strengthen

i) the regional aquatic system scientific capabilities;
ii) the links between aquatic scientists and resource economists; and
iii) the collaboration between scientific institutions in South Africa, Mozambique and Swaziland supported by specialist interactions with European partners.

The project uses as a case study the transboundary Maputo Bay-Incomati River system in Mozambique. Focus will be on the influence of runoff and material loads from the Incomati and Maputo river catchments on shrimp production in the bay. This resource and sector supports the livelihood of some 3000 artisanal and semi-industrial fishers (value of catches estimated to equal US$ 3.5 million in the early 1990ies).

The project comprises three phases, at the end of which it should be possible to identify the most important forcing factors in biophysical functioning of the catchment that affect the economics of shrimping in Maputo Bay. The complexity of the approach can be seen in the various modeling platforms involved:

- River hydrology and water quality;
- Groundwater hydrology and water quality processes in the Incomati estuary;
- Coastal-estuarine hydrodynamics and physical processes in Maputo Bay;
- Sediment and water column biogeochemistry in Maputo Bay;
- Mangrove ecosystem-habitat health and function in the Incomati estuary;
- Ecology of commercially exploited shrimp resources in Maputo Bay;
- Resource economics modeling of shrimp production in Maputo Bay;
- Integration of models and systems. This is the part where the policy and management interface will be located nourished by scientifically underpinned recommendations. Transferability to other tropical regions is anticipated.

Catchment2Coast relies on a partnership between six institutions in southern Africa and three centres in Europe. A rather modern feature of the project, paralleling other international efforts such as EuroCat and daNUbs (ELOISE cluster), is to strengthen the links between aquatic scientists and resource economists, and on the regional scale, to encourage institutional collaboration in the SADC region. The project will showcase the need for high-quality biophysical understanding, at the water-continuum scale, in developing ecosystem-based policy to sustainably manage the interaction of river catchments, coastal zones and their resources. Links to LOICZ II are mainly in **Themes 3** and **5** but also **1** and **2**. Catchment2Coast collaborates in the AfriCat process.

PIs: Pedro Monteiro* and Sue Matthews, * CSIR, P.O. Box 320, Stellenbosch 7599, South Africa, e-mail: p.monteir@csir.co.za (summarised from South African Journal of Science 99, 2003), http://www.catchment2coast.org/

### 3.3.3 Updates of ongoing Regional Projects

**LOIRA Report 2003**

In accordance with the LOIRA Plan 2003 the following works were carried out in 2003:

1. Expeditions.
   a. The 2nd cruise of the R/V "Aquanavt-2" to the estuarine zone of the North Dvina river and the Dvinsky Bay of the White Sea, 31 May- 10 June 2003, 7 participants, 19 stations (hydrology, hydrochemistry, geochemistry, hydrooptics).

b. The 57-th cruise of the R/V "Ivan Petrov" to the central part of the White Sea, 11- 20 June 2003, 15 participants, 30 stations (hydrology, sedimentology, geochemistry, biology).
c. The 55-th cruise of the R/V "Prof. Shtokman" to the central part of the White Sea, 21-30 August 2003, 31 participants, 40 stations (hydrology, hydrooptics, sedimentology, geochemistry, biology, radiochemistry).

2. Workshops.
   The 6-th International LOIRA Workshop jointly with the 15-th International Conference on Marine Geology was held in Moscow 17-21 November 2003 under financial support of the IASC and Russian Fund of Basic Research.
3. Projects under LOIRA umbrella.
   The INTAS project "Arctic coastal dynamics of Eurasia: classification, modern state and prediction of its development based on GIS technology" with participation of scientists of Russia, Germany and Norway was completed in 2003.
4. Publications.
   Collective monography "The Pechora Sea: integrated research (hydrophysics, hydrology, optics, biology, geology, chemistry, ecology, socio-economy)",
   E.A.Romankevich, A.P.Lisitzin, M.E.Vinogradov –eds., Moscow, "More & Yanus-K" Publish. House, 2003, 486 pp. (in Russian)

**** Land-Ocean Ineteraction in Southern South America, EU Title: A study of the transfer of particulate and dissolved phases Southern South America to the SW Atlantic Ocean, PARAT,**

Principal investigator: Prof. Jean-Luc Probst, AEE Laboratory, ENSAT/INP Avenue de l'Agrobiopole BP 107, 31326 CASTANET TOLOSAN Cedex
France; This LOICZ project also a contributed to the IGCP project n°459 "Carbon Cycle and Hydrology…" (IUGS-UNESCO), to CHANGES and the INQUA Carbon sub-commission. Though this EU and ECOS-Sud (French-Argentinian scientific cooperation) funded project which started in 1995 and had been finished in 1999 most recent publications in 2003 resulted form it listed under section 7.

## 3.4 LOICZ RELEVANT RESEARCH PROJECTS

The relevant research projects are contributed by chief investigators and institutions, and usually involve local- or national-scale studies. Eleven projects were completed in 2002 and publications are in-train to journals; a comprehensive publication list is being prepared for the LOICZ website.

The LOICZ database of projects is continually updated and is subject to annual review of the status and outcomes from each project. Recognising this dynamic, the following listing is representative rather than comprehensive and project listings and support information is available on the LOICZ webpage (www.loicz.org).

| Chief Investigator | Project Title | Country | Expected completion |
|---|---|---|---|
| Dr E. Hong | A study on the transportation and sedimentation patterns of sediments in the Tseng-Wen River deltaic system. | China ROC | ** |
| Dr J.J. Hung | Land-Sea Interactions in the Kaoping Coastal Zone in Taiwan<br>Sub project: Transports and Biogeochemical Processes of Carbon, Nutrients and Trace Metals in the Kaoping Coastal Zone in Taiwan | China ROC | 2004 |
| Prof. Jan Harff | Sinking Coasts, Geosphere, Ecosphere and Anthoposphere of the Holocene Southern Baltic Sea, SINCOS | Germany | 2005 |
| Dr. A.L. Paropkari | Study of sinking particulate matter and its dispersal on the Central Western Continental Margin of India by time-series sediment traps | India | 2003 |
| Dr R.P.M. Bak | Dynamics and diversity of coral reefs. | Netherlands | 2007 |
| Dr R.P.M. Bak | Gradients in coastal reefs and adjacent systems. | Netherlands | 2003 |
| Dr R.P.M. Bak | Small food web/benthos studies. | Netherlands | 2003 |
| Prof. J.P. Bakker * | Mechanisms involved in salt-marsh rejuvenation. | Netherlands | 2007 |
| Prof. E.A. Koster * | Biogeomorphological interactions within floodplains and their role in sediment transport and ecological transformation processes in the lower Rhine delta. | Netherlands | 2004 |
| Dr H. Ridderinkhof * | Transport of suspended particulate matter in the Dutch coastal zone. | Netherlands | 2004 |
| Dr J.S. Sinninghe Damste * | Archeal carbon fixation and burial and terrestrial organic matter input in the coastal system as revealed by tetra-ether membrane lipids. | Netherlands | 2004 |
| Dr H. Thomas | The continental shelf pump: a pilot study in the North Sea | Netherlands | 2005 |
| Dr H. Thomas * | Budgeting of carbon and related nutrient pools and fluxes in the North Sea employing a coupled hydrodynamic ecosystem model | Netherlands | 2005 |

Table continued

| Chief Investigator | Project Title | Country | Expected completion |
|---|---|---|---|
| Prof. V.N. Mikhailov | Delta forming processes and their mathematical modelling. | Russia | 2003 |
| Prof. V.N. Mikhailov | Mixing of river and sea waters at the nearshore zones. | Russia | 2003 |
| Dr E.S. Povalishnikova | Seawater intrusion into rivers and its mathematical modelling. | Russia | 2003 |
| Dr T. Jickells | Air-sea exchanges of trace elements particularly nitrogen and trace metals. | United Kingdom | 2003 |
| Dr C. Reynolds | Long-term assessment of physical and biological components in the waters of the Windermere catchment. | United Kingdom | 2004 |
| Prof. F.T. Mackenzie | Model analysis of global change in coupled C-N-P-S biogeochemical cycles in the land-coastal margin atmosphere ecosystem. | United States of America | 2003 |
| Mr. Adel M.A. Alhababy | Effects of socio-economic activities on coral reef conditions, Nukhaylay and Ghulayfiqah west coast of Yemen (Red Sea) | Yemen | Proposed; 2006 |

* PART OF REGIONAL PROJECT DUTCH LOICZ
** No information

**Relevant Research Projects completed in 2002:**

| Chief Investigator | Project Title | Country |
|---|---|---|
| Dr S. Appleyard & Dr B. Patterson | Role of groundwater discharge in causing environmental degradation in the coastal marine environment, Perth, Western Australia. | Australia |
| Mr C. Ajuzie | Monitoring for the presence of harmful microalgae in the Lagos and Lekki Lagoons, Nigeria. | Belgium |
| Dr N. Ramanujam | Monitoring and modelling of groundwater behaviour and cliff recession in relation to wave climate in the coastal belt. | India |
| Dr M.K.W. Osore | Assessment of marine pollution in a former mangrove creek. | Kenya |
| Prof. H.Camp Op den | Carbon cycling in the coastal zone of Tanzania. | Netherlands |
| Dr P. Hoekstra | Dynamics of suspended sediment in a marginal reef environment. | Netherlands |
| Prof. N.I Alekseevsky | Regime and dynamics of river mouth on the coast of the Caspian Sea under the influence of large-scale sea-level changes. | Russia |
| Dr V.N. Korotaev | Investigation of estuarine-deltaic systems morpholithodynamics. | Russia |
| Dr M. J. Bray | Environmental changes and management of coastal systems. | United Kingdom |
| Dr T. Jickells | Nutrient and metal cycling in estuaries and coastal environment. | United Kingdom |
| Dr Tran Duc Thanh | Sediment budgets and influence of moving and closing the inlets on the Tam Giang Lagoon ecosystem. | Vietnam |

## 4. WORKSHOPS & SYNTHESIS

### 4.1 LOICZ WORKSHOPS

#### 4.1.1 LOICZ/IHDP Scoping Team and 14th SSC Meeting, 18, 19 & 24 June 2003, Banff, Canada

Associated to the 3rd IGBP Congress the 14th LOICZ SSC meeting took place in Banff, high up in the Canadian Rocky Mountains. More than 50% new members were welcomed to this first SSC meeting of LOICZ II. A priority task was to design the roadmap for the next decade of LOICZ as a key partner within the widened context of the Earth System Science Partnership. Major challenges to be met in this new decade are to become a responsive and flexible continued learning mechanism rather than just a scientific program. The SSC and observers from IHDP and IGBP discussed which ways LOICZ should follow to accomplish this goal including a true integrative approach jointly with the Human Dimensions Science Community.

#### 4.1.2 LOICZ final lead authors Synthesis meeting, LOICZ IPO Texel, 1-3 Dec. 2003

A meeting of the lead authors of the LOICZ I synthesis book took place at the IPO Texel in December in order to have a final run on the draft chapters and to distil those key findings that needed to be addressed in the synthesis chapter. The goal was first to determine these findings and put them into an integrative context and, second, to derive the major gaps that will determine the roadmap for the LOICZ IIand need to be reflected in the draft SPIS.

### 4.2 ASSOCIATED WORKSHOPS

#### 4.2.1 European Conference on Coastal Zone Research: an ELOISE Approach; 24-27 March 2003, Gdansk, Poland and following Dahlem-type Synthesis workshops May, June 2003)

For ELOISE this year of synthesis was crucial in order to tease out major findings from the large project portfolio and to develop a vision for coastal research in Europe and the European Research Area following the 6th Framework Program. The meeting led to a set of Dahlem type conferences held in summer which resulted in a book production (details in section 3.3).

#### 4.2.2 Coastal biogeochemistry at the EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April 2003

During the EGS-AGU-EUG Joint Assembly, a special session was devoted to *Coastal biogeochemistry and its response to anthropogenic perturbations: inputs, gas exchange, carbon and nutrient cycling*. The session, which was co-sponsored by LOICZ and PNEC, the French Coastal Oceanography Program, focussed on the wide field of coastal biogeochemistry and provided both detailed insights into the state-of-the-art science as well as an excellent overview over achievements and open questions in this field. Three individual presentations, taken as representatives for the overall session, have been summarised by Thomas et al in LOICZ NL No. 28 (September 2003). Session's abstracts can be reviewed at **http://www.cosis.net/members/meetings/sessions/accepted_contributions.php?p_id=45&s_id=664**.

### 4.2.3 IGBP's 3rd Congress: "Challenges of a changing earth"; 20-23 June 2003, Banff, Canada:

Major issues discussed following a comprehensive set of presentations and working groups of the ESSP and IGBP were to draft the roadmap for the next phase of Earth System Sciences. LOICZ in particular has been more or less directly contributing to or taken the lead in various working groups aiming to identify mutual agendas, ways of collaboration and to avoid overlap. Those working groups were:

- N, C and P cycling in continental margins
- Vulnerability of coastal communities to natural and human-induced changes in living marine resources GLOBEC
- Global change and the water continuum LOICZ/GWSP
- Oceanographic data management (followed up by SCOR)
- Ocean implementation issues
- LOICZ/GLOBEC

Discussions were fruitful and are reflected in the draft implementation strategy. The contacts will be continued and direct talks are expected for the next IGBP SC meeting in Moscow 2004. A priority was the interaction with the IHDP core projects which led to initial plans to have a first joint LOICZ IHDP session on coastal zones at the following Global Human Dimensions Meeting in Montreal in October ( see below).

### 4.2.4 daNUbs meeting, Athens, Greece, 2-6 July 2003

daNUbs, the second large scale and transboundary catchment – coast interaction project in the ELOISE cluster had its major mid term review meeting in Athens. LOICZ had been invited to assist in the evaluation and point out the interfaces to other LOICZ activities and global research. This engagement in collaboration with EuroCat (see section 3.3) resulted in a joint proposal to the Australian Government for a European/Australian Catchment-Coast interaction workshop in 2004 or 05. LOICZ will further engage with it associated programs such as daNUbs and EuroCat to further develop this field of studies and integrated modelling. Important thrust in this field is expected to come from the new links between UNEP GPA and its ICZRM pilot sites and LOICZ.

### 4.2.5 Information to support sustainable water management: From Local to Global Levels; 15-18 September 2003, St.Michielsgestel The Netherlands.

The LOICZ perspective on future challenges to the scientific community to become truly integrative and flexible was presented to a global forum of scientists and science users. Implications for monitoring and therefore links with for instance Coastal GOOS and in general the Earth Observation efforts were addressed. For information visit: www.mtm-conference.nl

### 4.2.6 Global Environmental Change and Coastal Systems: A Microcosm of Coupled Human-Environmental Systems; a first joint panel of the ESSP and HD projects GECAFS, GECHS, GLOBEC, IDGEC and IGBP-LOICZ at the 2003 Open Meeting of the Human Dimensions Community, Montreal 16-18 October

The global "coastal zone" is the domain where the coupling of human and environmental systems is reflected most explicitly and where effects overlie the most powerful physical, biological and chemical processes in both, ocean and land dominated systems. New GEC work on this complex domain would examine to a much greater extent the linkages amongst various sectors in the coastal zone rather than viewing each sector in isolation and include the contributing catchments as one of the most powerful triggers of coastal change signals.

Four core projects within the IHDP and IGBP families are especially well-poised to develop and lead the development of a new research collaborative exploring human-environment systems in the coastal zone. GECHS has taken a lead in identifying human vulnerability to GEC. GLOBEC, the Global Ocean Ecosystem Dynamics project, is examining the responses of marine ecosystems to global changes; one of its sub-themes examines the social consequences and feedback of changes in marine ecosystems. IDGEC has pioneered research into the performance of exclusive economic zones as a means to manage marine resource. LOICZ has developed scientific knowledge and tools that address global change in the coastal zone, focusing on material flux and human dimensions at regional and global scales.

Chaired by Mike Brklacich, GECHS, Carleton University, Canada, the panel in contribution to the Open Meeting's overall theme of "Taking Stock and Moving Forward" provided four presentations from each of the core projects summarising their respective perspectives on coupled human-environment systems in the coastal zone.

- *Communities of fish and Communities of fishers: understanding human-ecosystem interactions in the coastal ocean* by Rosemary Ommer, GLOBEC SSC, Coasts Under Stress Research Project, Canada, coauthors: Barbara Neis, R. Ian Perry
- *Institutional Dimensions of Global Environmental Change in Coastal and Marine Systems* by Syma Ebbin, (IDGEC), United States, coauthors: Are Sydnes
- *Environmental and Human Dimensions of Coastal Change (A challenging perspective from the new LOICZ project)* by Hartwig Kremer, IGBP/LOICZ (Land Ocean Interactions in the Coastal Zone), the Netherlands
- *Reducing Vulnerability of Coastal Communities to Global Environmental Change* by Maureen Woodrow, Global Environmental Change and Human Security Project, Carleton University, Canada, co-authors Mike Brklacich
- *Global Environmental Change and Caribbean Food Systems* by David Brown, CARICOM Caribbean Regional Fisheries Mechanism, Belize, for GECAFS

In a first concluding discussion a sub-group of the panel decided to embark on a more regular dialogue and in a first step to identify common scientific questions to be addressed in a joint publication effort (early 2004). The goal is to test and show case if such a collaborative research will provide a value adding synergetic critical mass of scientific information that may at a later stage lead to terms of reference and enhance information sharing for future joint activities amongst these projects.

### 4.2.7 Joint XV International Conference on Marine Geology and IV LOIRA Workshop; 17-21 November 2003, Moscow, Russia

LOIRA keeps forming a nucleus of regional LOICZ work in the Russian Federation. This workshop took stock of the activities and findings so far and evaluated the other activities carried out in 2003 (see section 3.3). Together with the newly acquired ACD project (see secion 3.3) LOICZ can now rely on two complementing efforts dealing with complex global change issues in the Arctic. Contact: Dr. V.V. Gordeev, Institute of Oceanology, 36, Nakhimovsky Prospect, 117997, Moscow, Russia. Fax: ++ 7-095-124 59 83 or e-mail: gordeev@geo.sio.rsso.ru or school@geo.sio.rssi.ru

## 4.3 OTHER WORKSHOPS AND CAPACITY BUILDING

In 2003, LOICZ scientists were involved in wide-ranging coastal zone activities, including assessment, scoping meetings and networking activities. Emphasis was on provision of the status of the LOICZ Synthesis and its Future planning, including investigation of opportunities for formal and operational links. LOICZ has been consulted by agencies for comment on and help with their future planning and has been involved in the development of visions and science plans of allied core projects and joint projects of the IGBP II and the Earth System Science Partnership, namely Oceans, SOLAS, OCEANS-Vision and LAND-Vision and the Global Carbon Project, GECAFS and the Global Water Systems Project, GWSP. Further to that LOICZ became involved in the launching of a national German research initiative aiming to establish a set of pilot investigations and networks in the filed of science for integrated coastal zone management.

In addition, presentations of research findings and materials and operational approaches taken by LOICZ on how to engage with the user community and address coastal management issues were fed into an increasing number of capacity building efforts LOICZ has supported. The following meetings have been attended by LOICZ representatives (names in brackets):

**OCEANS (later renamed IMBER) meeting Paris, 8-11 January 2003 (various)**

**IGBP SC Punta Arenas, Chili + IAI Mendoza, Argentina, 18-30 January 2003 (Jozef Pacyna in representation of Han Lindeboom and Hartwig Kremer)**

**IHDP Meeting, Bonn, Germany , 4-5 February 2003 (Hartwig Kremer)**

**American Society of Limnology and Oceanography, ASLO, Salt lake City, USA; (Steve Smith); see NL 28, Sep. 2003 for detail.**

**IKZM, Bonn, Germany 10-12 February 2003 (Hartwig Kremer)**

**WWF Conference. Kyoto, Japan 14-20 March 2003 (Hartwig Kremer)**

**Estuarine Research Federation, ERF, Seattle, USA, September (Steve Smith, and Gerardo Perillo); for detail see NL 28 – Sep 2003.**

**6-10 October, Portsmouth, USA: GWSP meeting (Jim Syvitski)**

**1-9 November, Hamilton, New Zealand: IGOS meeting. (Liana McManus)**

**Geesthacht, Germany, 1-4 November, LOICZ Futures and IPO Node discussions (Hartwig Kremer)**

**6-7 November, The Hague, Netherlands: GPA – ICARM sites and Freshco Partnership (Hartwig Kremer)**

**12-14 November, 2003, UNESCO, Paris, France: The Global Conference on Oceans, Coasts, and Islands. For information about local facilities at UNESCO contact Julian Barbiere at: j.barbiere@unesco.org (attendance: Michel Meybeck, Peter Burbridge and Russell Arthurton)**

**3-7 December ,Addis Ababa, Ethiopia: UNESCO session at the African Partnership conference on water and preceeding PACOM meeting (Russell Arthurton)**

**8 December, Liverpool/SCOR, Data needs and management issues in ocean related global change projects; (Liana McManus in representation of Laura David, Martin Le Tissier); outcomes of this meeting will reflect in the SPIS development and have been addressed in section 3.2. in detail.**

### 4.4 LDC COVERAGE, CAPACITY BUILDING AND TRAINING:

**Regional focus, involvement of LDC scientists and capacity building**

Of the LOICZ network of scientist more than 50% are from LDCs. Capacity building activities and a regional focus remain core actions within LOICZ receiving increasing attention in the second phase.

Establishment of "Thematic/Regional IPO Research Nodes" (section 5) as part of a distributed LOICZ IPO will broaden the operational base in the region and contribute to enhanced regional researchers involvement, integration and networking with a key focus on developing economies. This applies in particular to the operational Node in Singapore with a focus on SE Asia and the ones in progress such as Australia (with focus also on small island states in Oceania), in Brazil and Africa (negotiations will commence in Feb. 2004. An effort to include a South Asian Node will be started in late April 2004.

Training and capacity building form a considerable part of the ongoing research linking catchment processes and coastal change in Africa (AfriCat – supported by START, UNESCO IOC IHP and NEPAD). LOICZ will continue and further strengthen its effective operational links with START to support this process and provide appropriate platforms for capacity building needed to implement the new science plan. We also continue and even enhance our cooperation including advising the small grant programmes of the APN and IAI and encouraging applications.

SSC membership suggestions usually feature a good coverage of LCD countries and the new category of "corresponding membership" will allow LOICZ to build further the regional networks and involvement of in particular young scientists in LDC countries (as elsewhere). This also forms a pool for their later involvement as full SSC members.

A growing share of proposals encouraged and informed by LOICZ focus on coastal change and human dimensions in developing economies. We expect that by forging links with the wider IHDP community the contribution by and opportunities for scientists from these target regions will see a major push.

**Targeted activities**

**NASA, ITU, LUCC & IGBP, endorsed by LOICZ Int. Colloq. Series on LUCC Science and Applications Conference: "Studying Land Use Effects in Coastal Zones with Remote Sensing and GIS"; 13-16 August 2003, Antalya/Kemer, Turkey.**

With considerable support form SCOR two young scientists, Dr Maria Zoran*, Romania, and Mr Imassi Saïd**, Morocco, have been supported to participate in this colloquium addressing the role of remote sensing in future integrated studies on land processes affecting global coastal zone. By presenting case studies on the "*North-Western Black Sea and Danube Delta Coastal Zone Environmental Impact Assessment by Satellite Remote Sensing Data*" and "*Historical shoreline changes at the Moulouya deltaic coast in connection with land use effects*" respectively they contributed to the broader context of the conference: *Natural Processes and Impacts, Linking People and Pixels to Ecosystems and New Tools & Methods*.

Under the chairmanship of Dr. Garik Gutman (NASA) and Prof. Derya Maktav (ITU, Turkey) the scientific presentations and panel discussions of this interdisciplinary natural and human dimension colloquium focused on the analysis of the complex interactive forcing in coastal zones i.e. biological, chemical, geological and physical processes that define coastal system dynamics.

Particular attention was paid to the role of human activities on land in affecting and changing these processes. Remote sensing methods and new applications were reviewed and advanced applications highlighted as a crucial means to inform the important integration between natural and social sciences for assessing, modeling and predicting coastal change at local, regional and global scales.

Capacity building activities including tutorials on "*Power and Limitations of Remote Sensing and GIS in studying land use effects in coastal zones*" addressed participants' needs to build experience with new technologies and data processing incl. GIS, LANDSAT, MODIS, IKONOS data. In addition participants and in particular young scientists from developing economies were enabled to establish scientific links relevant for their future activities.

LOICZ is particularly grateful to the participants for their contribution and to SCOR for supporting the engagement in this activity. The published proceedings of this colloquium can be ordered via http://www.ins.itu.edu.tr/rslucoast1/.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## 4.5 SYNTHESIS

The LOICZ synthesis book is underway with five chapters prepared in final draft stages ready for review. A final lead authors meeting held in late 2003 on Texel distilled the key finding from the chapters in order to feed them into a concluding chapter providing a future and management context. The LOICZ synthesis book is planned to be published by Springer and a challenging target for Galley State has been set for second half of 2004. The work has involved a large number of scientists from many countries in writing teams co-ordinated by a chapter author. The synthesis will have a focus on the global and regional levels providing, global assessments and delivery of findings against the 5 LOICZ (I) objectives. The changes brought by the human dimension experts are increasingly evident in the assessments, and both qualitative and quantitative data are providing firm support for this milestone in LOICZ contribution to the IGBP Global Change evaluation. Below is a brief summary of the scientific key features to be reflected in the Synthesis Book chapters:

In general the focus of the Synthesis work is on material flux models and processes, and the human dimensions. While most of the scientific research has been focussed at local to regional scale, a principal role of LOICZ is in the integration of data and information at regional to global scale. This comprises findings from the river catchment-basins, biogeochemical budgeting, and scaling approaches and how they relate to the key features of the changing earth system, identified by IGBP:

- The Earth is a system that life itself helps to control.
- Global change is much more than climate change. It is real, it is happening now, and in many ways it is accelerating.
- The human enterprise drives multiple, interacting effects that cascade through the Earth System.
- The Earth's dynamics are characterized by critical thresholds and abrupt changes. Human activities could inadvertently trigger changes with catastrophic consequences for the Earth System.
- The Earth is currently operating in a non-analogue state.

These findings have opened up serious conundrums for scientists in order to understand issues such as the extent and effects of teleconnections across large spatial scales of processes, the increased awareness of the non-linearity of biogeochemical system responses to multiple forcing, and questions about the potential for feedback and sudden changes in the poise of systems, and thresholds for change in Earth systems processes.

With these findings in mind, the major purpose of each of the preliminary draft chapters in their most recent version (early 2004) is as follows:

**Preface**
The text provides a short history of the IGBP and LOICZ, mission statements, development and approach. The context of the book is also outlined.

**Chapter 1 – The Coastal Zone - A Domain of Global Interactions**
*Lead Authors: Chris Crossland, Dan Baird, JP Ducrotoy, Han Lindeboom*
This chapter provides a contextual framework for the coastal zone and its vital interactions, including information about its resources, societal and environmental benefits and values, and an overview of the natural and human pressures and threats that affect the significant changes and dynamics of the global coastal zone. A synopsis is provided of key methodologies and approaches developed and used by LOICZ to assess key issues about material fluxes and the interactions between pressures and system responses in this dynamic domain.

**Chapter 2 – Dynamics of the coastal zone**

*Lead Authors: James P. M. Syvitski, Nick Harvey, Eric Wolanski, William C. Burnett, Gerardo M. E. Perillo, Vivien Gornitz*

The world coastline has evolved for many thousands of years, experiencing changes to habitat, coastal dynamics and the supply of sediment from the continental interior. Relative sea level has risen in some areas, but fallen elsewhere. Human impacts on the coastal zone can range from massive (e.g., reduction in wetlands, urbanization) to non-existent (e.g., many polar coastlines). This chapter synthesizes how humans and climate shifts can and have affected our coastlines on a global scale.

**Chapter 3 - C, N, P Fluxes in the coastal zone**

*Lead Authors: Stephen V. Smith, Robert W. Buddemeier, Fredrik Wulff, Dennis P. Swaney*

This chapter primarily details rationale and outcomes of the biogeochemistry and nutrient work of LOICZ applied to the derivation of site-specific nutrient budgets and estuarine metabolism and the up-scaling to regional and global assessments using typology.

**Chapter 4 – The Catchment-Coastal Region Continuum**

*Lead Authors: Wim Salomons, Hartwig H. Kremer and Kerry Turner*

This chapter describes the LOICZ Basins approach of an expert typology of the current state and expected trends of coastal change under land-based human forcing and natural influences. The assessment follows a set of key questions that cover the various aspects and scales of the DPSIR analysis and follow a sequence of assessment tables. The text summarises some pertinent results focusing on the regional and continental scale. The continental regions of Latin America, Africa, East Asia and the Russian Arctic are used as examples. Results for Europe, using a slightly different, scenario based procedure are also discussed.

**Chapter 5 - Synthesis of Main Findings and Conclusions**

*Lead Authors: Peter Burbridge, Robert Costanza, Robert W. Buddemeier, and Martin Le Tissier*

This chapter focuses on collating and contextualising the outcomes from LOICZ outlined in the previous Chapters translated into key issues and contributions to coastal management. The text outlines the future challenges for the LOICZ IIin terms of its science, incorporation of human dimension elements and contributions to coastal management. Am emphasis is placed on the management goals and needs as well as identifying the gaps approaches to which LOICZ can contribute.

# 5. THE NEW LOICZ II

The ongoing synthesis together with continued engagement with the science community including in particular the human dimensions colleagues in the joint LOICZ IHDP scoping team has also had a remarkable effect on the review and revision of the LOICZ Future Document into the first final draft of the LOICZ II Science Plan and Implementation Strategy (version 30 Jan 04). In a joint scoping team LOICZ and IHDP experts, and the SSC have paved the way towards a "Theme arrangement" that will have the potential to make the LOICZ II evolve into a truly integrative and participatory effort. This was supported by the continued further development of initial plans to come to a semi-parentship/co-sponsorship agreement between LOICZ and IHDP, which has been discussed during the 14th SSC and is under consideration (IHDP SC, late March 2004).

## 5.1. THE PLAN

The joint scoping team of IHDP and LOICZ SSC representatives started to develop the LOICZ II Science Plan in late 2002. Each IHDP core project and the recently launched urbanisation task team are represented. A first scoping meeting will be held prior to the upcoming 14th SSC Meeting in Banff, Canada, June 2003.

It is anticipated that the LOICZ II Science Plan would be organised along five themes. In addition, there will be joint and cross-cutting tasks with other IGBP and IHDP core projects (e.g., OCEANS, GLOBEC, SOLAS, PAGES, IDGEC, GECHS, IT, LUCC and the urbanisation initiative). Further over-arching initiatives are required across the wider LOICZ project (e.g., development of additional tools and activities for scaling, scenario developments, integration and indicators of change). Specific thematic workshops or *ad hoc* working groups will support this approach.

Theme Leaders have been appointed (see section 2) and should be supported by a working group of scientists in planning, implementing and co-ordinating each research activity. Task work in each thematic area, while addressing the global perspective, would be directed in particular at studying and evaluating at regional scales and would aim to have support from national research funding and actions.

### 5.1.1 Statement of Goals and Objective

Considerable progress has been made in generating a comprehensive overview of the changes in earth system process affecting the coastal zone, the role of coastal systems in global change, and the current state of coastal metabolism that includes the identification of simple proxies in the form of demographic and hydrological parameters that can support the prediction of the state of coastal systems. However, it has also become clear that irrespective of our improved understanding of coastal system metabolism and to some extent its drivers and pressures, there remain major interrelated challenges of confronting and managing the consequences of global environmental change whilst addressing and securing a sustainable future. In order to maintain a sustainable delivery of goods and services for humankind, science needs to better inform society, decision-makers and planners about:

- global changes that are part of natural cycles of change, such as climate, and those due to changes in the global economy/trade and policy;
- regional (trans-boundary and supra-national) changes as a result of regional and national drivers and pressures in the coastal zone; and
- regional changes at the river catchment level which affect the downstream coastal zone and the near-shore marine environment.

Our current limited understanding of regional and global changes that impact coastal systems is hampered by traditional disciplinary fragmentation. Therefore the primary goal of the LOICZ II will be to:

***"to provide a framework for integrated analysis and dissemination of existing information and to act as a means to focus on key issues concerning human activity and resource use in the coastal zone by applying the full water-continuum scale including river catchments and the EEZ as spatial scales of major human interventions"***

Consequently, the LOICZ II aims to overcome traditional disciplinary fragmentation, in particular between natural and human dimension sciences, and to focus on key issues concerning human activities in the coastal zone (including applying the full catchment scale as part of the water-continuum). Closely related goals will be to identify and promote ways to transfer information to the stakeholders about what is being learned from the science, and to identify what needs to be answered by science. An underlying principle of the new LOICZ framework is to continuously engage in a "science–policy–public" issue driven dialogue addressing scientific information needs as well as human development and implementation issues. The LOICZ II will address the primary issues of sustainable human use of coastal systems in respect to vulnerability of coasts and risks for human uses through pursuit of the following objective:

***"to assess, model and predict the change in adaptive capacity of the global coastal zone as an integral part of the Earth System under multiple forcing, including the contribution of, and consequences for, human activity"***

The goal and objective look forward to the contribution the LOICZ II will make to both Earth System research and coastal problem solving on various scales and dissemination that is articulated through a mandate for the "New" LOICZ:

**The LOICZ II Mandate**

To inform, firstly, Earth System Sciences on the relevance of global change in coastal systems and the feedback loop into coupled natural and human systems (global scale commitment) and, secondly, management relevant policy-making fora and stakeholders on appropriate scales, with solid scientific information, on coastal change and sustainable use options (issue driven commitment).

To develop a research framework for interdisciplinary analysis of existing information and generation of new research integrating biogeochemical, biophysical and human components of coupled human and environmental coastal systems, whilst recognizing the need to work across disciplines as well as temporal and geographical boundaries.

To provide within this research framework a flexible infrastructure able to respond to new research demands in a reasonable time through the establishment and operation of appropriate networks of excellence encompassing a range of scientific disciplines spanning natural and socio-economic sciences.

To conceptualise a framework for science dissemination, continued participation, and regular review of goals and scientific questions in a process of ongoing synthesis, translation and exchange of results and their outcomes with scientific, non-scientific and public community. This includes strengthening research initiatives contributing to the LOICZ objective and goals on a national, regional and international scale.

To provide a global platform for facilitating and coordinating international, regional and national coastal research initiatives to improve the design of observation and research networks, data and information standards, information transfer and timing of campaigns and process-based experiments, and the development of model-data fusion techniques

The strategic aim for the LOICZ II is to further develop the utility of the scientific outcomes derived from its first phase, complemented by the search for new knowledge and understanding. Major coastal change issues will play the leading role in driving the science. Outcomes will be used to inform and strengthen management of land-ocean interactions to reduce vulnerability of human activities in coastal regions and enhance opportunities for sustainable social and economic development. To achieve these objectives, the Driver-Pressure-State-Impact-Response (DPSIR) framework will assist organising the "New" LOICZ' science in seeking to develop both conceptual and quantitative models which ultimately feed in scenarios to:

1. Expand our understanding of the interplay between natural and anthropogenic factors influencing land-ocean interactions; and to
2. Identify options for managing land-ocean interactions to avoid risks to life, property and investment whilst sustaining the wise and equitable use of coastal areas and the natural resources derived from terrestrial, coastal and marine resources.

The implementation plan incorporates a re-organized theme structure designed to provide (i) improved scientific information for advanced Earth System analysis and modeling and (ii) better science for better management to achieve a more "adaptive science" approach in order to develop adaptive management options and provide the mechanisms to satisfy short-term information needs and back them up with in-depth, sophisticated interdisciplinary science.

### 5.1.2 Science Themes

The LOICZ II strategy is designed to provide improved integrative and policy relevant scientific understanding of the coupled biogeochemical, physical and human dimensions of coastal change that contributes to the goals and objectives of IGBP-II. It will address questions posed in the IGBP-GAIM program through five themes that form the backbone of the scientific activities. All five themes have three challenges in common, (i) up-scaling of regional science results and management issues for global science and policy/management agencies and, similarly, down scaling making global science results available to regional stakeholder and manager; (ii) at a local and regional scale distinguishing between the impacts of local or regional versus global drivers and pressures; and (iii) combining expertise from natural and social scientists and stakeholders to understand and contribute to solutions for sustainable use of the river basin-coast-shelf continuum.

**Theme 1: Vulnerability of Coastal Systems and Human Safety** sets the stage for the subsequent themes that address special parts of the wider coastal domain. It is integrative in nature and deals with coupled human and ecological system change, carrying capacities and vulnerability issues including the risk of degrading sustainability of coastal goods and services delivery under different scenarios of future change. The principle rationale here is that risk and vulnerability originating from change, both natural and anthropogenic, constitute the greatest risks to Human populations and their resource use. The theme is the major Driver of the LOICZ II science aiming to generate awareness of the distribution and dynamics of risks and levels of uncertainty on hazards affecting goods and services at global, regional and local scales. It should take the opportunity to establish a strong modelling component giving room for both, integrated assessment and agent-based modelling.

**Theme 1 Key Issues:**
**The effect of non-linearities and uncertainties on vulnerability of coupled society and ecosystems to global change hazards in the coastal zone.** Differentiate and quantify how natural versus human-induced changes impact on our understanding of risk, uncertainty and predictability and how societies in different cultural and historical settings tend to respond.
**Community's stakes in the coastal zone including resources goods and services**. Develop a strong socio-economic dimension not only encompassing conceptual work on co-evolution from an ecological economics perspective, but also place-based analysis of vulnerable coastal communities and their response to hazards.
**Exogenous and internal factors of vulnerability**. Adequately describe the external and internal factors and their dynamics including variability of social risk perception and response that determine risk and vulnerability of coupled environmental and human coastal systems.

**Theme 2: Implications of global change and land and sea use on coastal development** focuses on increasingly contentious spatial, temporal, and organisational issues of coastal change, and land and sea use, and how they influence natural resources availability and natural systems sustainability. The principle rationale here is that development and change in the coastal zone affects the interactions and processes that determine the nature of the Land-Ocean boundary and functionality of coastal systems that may be critical at a regional and/or sub-regional to local level. LOICZ will therefore include integrated assessment of the roles of economic, ecological, social-cultural, institutional, political, and technological domains in accounting for this variance. Examples for increasingly competitive land-sea use issues are wind farms, sand mining, artificial islands in the sea, aquaculture. On the landside increasing demands for coastal resources derive among others from demographic development, and infrastructure needs for tourism and transportation.

**Theme 2 Key Issues**
**Nature and location of different boundaries of coastal environmental and social systems, and their tapestry of interactions**. Define a variety of "impact areas" featuring loss of ecosystem services, increase in substance flow, loss of habitats and bio-diversity including their protective functions, and the variety of human risk and safety issues at different scales for society and resource management
**Coupled systems sensitivity and robustness**. Assessment of how much and how fast can changes to the biogeochemical and/or hydrological cycle be inflicted on a system and still allow it to return to an 'acceptable situation'? (Including a thorough consideration of natural variability, the potential role of different assemblages and habitats in sustaining the integrity of coastal systems and Earth processes adaptive capacity, thresholds, triggers and services).
**Quantifying human impact.** Quantification of the human impact on coastal units through natural science and ecological economics indicators including valuation methods. This includes case studies of conjunctive land and sea use examples such as reclamation, mining, aquaculture and urban interactions (the range of scales of urban systems, not just mega-cities) that place different demands on the 'estuary filter/buffer', allowing identification of various levels of sustainability.
**"Design" of robust coastal systems.** Identification of options to design and manage system robustness through a scenario approach – not just "sustainability" but with elastic rebounds expressed by thresholds and critical load identification. Use of tools and information, e.g., the biogeochemical budgeting approach, for wider application to coastal problems by, for example, reviewing nutrient budgets in consideration of how ecological balances can define sustainability. Use of the typology approach at various levels of systems to classify 'estuary' types on the basis of controlling factors.

**Theme 3: Anthropogenic influences on river basin and coastal zone interactions** address river catchment–based drivers/pressures that influence and change the coastal domain. The whole water cascade (source to sea) is considered as a single system. Transport processes across the ocean boundary and anthropogenic influences through activities in the EEZ are included in particular through links with theme 2 and 4. The principle rationale here is that river basin - coast interactions reflect a coupled human and natural system that affects the magnitude and variations in land-derived material loads to the coastal seas and atmosphere, feeding back on human uses and coastal functioning. LOICZ in its first phase has identified major gaps in our scientific comprehension of the implications of these hydrological, and land-use induced impacts on temporal and spatial scales that characterise the water continuum. However, while most of the benefits of appropriate, science-informed management will be gained at the coast, many of the costs will be incurred within the river basin. Thus an important role in informing coastal management is to recognize the considerable variety of culturally biased social perception of the coastal zone, its value functions and the resulting spectrum of definitions of 'natural' or 'acceptable' environment conditions along the whole catchment. To fulfil this role the LOICZ II aims to take a narrative role showing the trajectory of change along the river basin - coast systems, providing projections into the future, and highlighting the critical system switch points for decision and intervention

**Theme 3 Key Issues**

**River basin and coastal zone as one system – investigating the water continuum**. Disentangling the cause–effect relationships of those impacts and human activities which are strictly coast or river basin-oriented (regional) from those derived from much wider external pressures on the river-coast system, such as climate change, population pressure and the global economy.

**Alternative approaches for modelling coupled human/natural systems in river basins**. Build on experiences within the current LOICZ Basins project to extend the DPSIR approach and assessment framework for links between major anthropogenic and natural pressures in river catchments affecting coastal ecosystems over the years. Focus on model development, testing, improvement and application including assessment of water residence effects on sub-catchment scales, groundwater fluxes and dynamics, and clustering of information in functional and management units.

**Scenarios of coastal change.** Building on the above elaboration of future scenarios for projected states and impacts on systems in consideration of various pressures such as different land use and climate change patterns, response (management) options. This includes a thorough consideration of global economic settings, incentives for conservation and in principle functions triggering social choice.

**Participation**. An evaluation of societal, including institutional, dimensions and changes, and their ramifications can be based on the management units and built into the future scenarios. Therefore a continued involvement of users based on redefined coastal management units (on basins scale) needs to be established to better reflect basin-coastline linkages (e.g., through initial stakeholder inventories).

**Theme 4: Fate and transformation of materials in coastal and shelf waters** by drawing on the results of themes 2 and 3, focuses on the cycling of carbon, nutrients and sediments in the coastal and shelf waters and their exchange with the ocean. This recognises that the coastal waters are the principal locality for vital benthic effects influencing the shelf ecosystems (and their use) and global chemical cycles, and that processes here are changing. The principle rationale here is that fate and transformation of materials on the continental shelf from land-based and atmospheric loads are the driving forces affecting this major fabric

of coastal water processes including trophic interactions. Continental shelf systems, however, are under growing pressure from human activities, e.g., through activities in the EEZ associated with transport (shipping), fisheries and recreation and in river catchment basins. Ramification of resulting material dynamics in the coastal and continental shelf seas, and the implications for Earth System function remain major research foci.

**Theme 4 Key Issues**
**Shelf processes undergoing change.** Quantification of transport of materials within and across the continental shelf, transformation of materials within the water column and sediments, storage of materials in the coastal zone, air-sea exchange, and changes in energy levels.
**Resilience of shelf systems.** Assessing regional differences and assess why some shelf waters are more resilient or robust to change than others.
**Scaling of boundary conditions of shelf processes**. Improve the definition of the landward boundary condition for nutrient fluxes through better integration of river basin information, sediment dynamics, organic loading and nutrient inputs (including estimates of how much of the load would not reach the coastal zone and to differentiate between natural and anthropogenic influences).
**Linking to ocean cycles**. Develop regional budgets and flux estimates for shelves and coastal waters as part of ocean cycles in order to understand and predict the impact of global and basin scale changes in ocean climate and biogeochemical cycles on continental shelves and coastal waters (a rather high technology based large scale approach).
**Human dimensions of shelf processes.** Evaluate the effects of changing inputs on ecosystem health, goods and services of the coastal zone applying a full ecosystem perspective hence to include the fundamental link between biological functioning, geochemistry and human drivers. (Small scale approach building among others also on the use and further development of biogeochemical modelling and coastal typology activities of the first LOICZ phase).

**Theme 5: Towards coastal system sustainability by managing land-ocean interactions** provides an overarching integration cutting across the four other themes. It is expected to serve as a platform addressing the development of the coastal zone and management of its resources, thus the people using them, in the context of strong and weak sustainability options. It should consequently not be considered as a freestanding disconnected research field. The principle rationale here is that coastal system integrity and resource stability is required for sustainability and management. In parallel growing competition for marine and coastal space calls for immediate sound information on actual and predicted use options and their ecological and monetary evaluation. Institutional conditions for resolution of cross-boundary spatial conflicts including the precautionary principle, as a means of coastal zone management are major issues to be addressed.
In recognition of the policy perspective where scientific knowledge and insights constitutes one element of a consultation process with stakeholders the LOICZ II focussing on coastal zones and their sustainable use needs to put the science back into the context of the issues. In this way LOICZ, will build its own capacity to be responsive, issues-related and adaptive paying priority attention to issues needed to underpin sustainability in a scientific way. The theme is strongly relying on the close interaction and exchange with the other components.

**Theme 5 Key Issues**
**Multiple scales and institutional dimensions**. Consider the multiple temporal and spatial scales including institutional dimensions relevant for both the pure scientific but also the management perspective of coastal change issues in the "Anthropocene".
**Driver-Pressure–State-Impact-Response Settings.** Classification and clustering of, and comparison between different DPSIR settings of driver/pressure coastal system state interactions and existing responses by applying advanced typology approaches. This should enable an integrative assessment, development and application of both conceptual and quantitative models on the appropriate scale.

**Probable, sustainable, and desirable "Futures" scenarios**. Transform linked natural, economic and human dimension information into scenarios. Ultimately provide and apply integrative indicators allowing formulating quality targets (environmental and standard of living), and incorporate them into the necessary monitoring and analysis in relation to these targets.
**Management options and participation**. Derive from these scenarios alternative response options that integrate policy/management/investment communities into their assessment and development.

### 5.1.3 Cross-cutting Science Activities and Joint Tasks

In consideration of the above and to provide infrastructure support as well as integrative capacity to the Theme implementation, a set of cross-cutting activities has been agreed upon so that the LOICZ II will have an emphasis in its outputs upon:

**a)** **Scaling and Modeling**, and
**b)** **Variability**

These two cross-cutting activities are science related and conceptual (i.e., scaling and modelling), and consideration of variability and uncertainty. They will guide the development of research questions. All research elements will deal with modelling approaches and the measure of scaling and uncertainty in the assessment of spatial and temporal variability across the global coastal zone. Here, an imperative for the LOICZ II program will be effort directed towards the development of models applicable to coupled human/natural systems.
Key aspects that have to be addressed in scaling and natural variability are:

- Natural variability of the coastal zone in space and time.
- Changes in vertical and horizontal fluxes across decadal and century scales.
- Identification of non-linear changes, isolated events and thresholds in the context of long-term variability.
- Tools for integration of "small pictures to big picture" (scaling and capacity building by application of tools/information at regional-local scales - getting away from solely top-down approach).
- Linking typologies and "biogeochemical budgets" through improved tools and concept developments.
- Prediction of changes and potential outcomes.

**c) Dissemination**

LOICZ has disseminated its outputs widely through conferences, workshops and meetings as well as through published products available as hard copy and through the website (http://wwwold.nioz.nl/loicz/firstpages/products/fp-products.htm): These activities will continue in the LOICZ II with a new website hosted at www.loicz.org . A challenge for the LOICZ II is to extend its output and outreach activity to encompass the human dimensions of Global Environmental Change (GEC) that comprise the causes and consequences of people's individual and collective actions, including changes that lead to modifications of the earth's physical and biological systems. These changes affect the quality of human life and sustainable development on a world-wide scale and it is important that the LOICZ II contributes its science in a manner that makes a significant impact to the sustainable exploitation and management of the World's resources. We envisage activity, mediated through Theme 5 that collaborates with and compliments Human Dimensions of GEC research that addresses the coupled human-nature system and investigates how individuals and societal groups (i) contribute to, (ii) are influenced by, and (iii) mitigate and respond to changes that take place on a local, regional and global level.

The "New" LOICZ, which will likely involve experts from the IHDP will review the participatory and communication mechanisms needed in order to ensure that the outputs and, importantly, the outcomes of environmental science are made available outside of the scientific sector and community. In the contemporary world the failure to transfer knowledge and learning that can affect managerial and societal attitudes is a significant barrier to improved environmental management and governance. To improve the societal capital of scientists LOICZ will develop a project to expand the metacognitive (thinking about thinking) skills of the LOICZ community to develop strategies to communicate the relevance and context of outputs and outcomes to managers and society. To achieve this, LOICZ plans to collaborate with the Australian Coastal CRC, which has a goal to "bridge the gaps between science and the community; and between science and decision-making policy and planning", to establish an awareness of the context, needs and functioning of the workplace and societal arena to which the LOICZ science contributes.

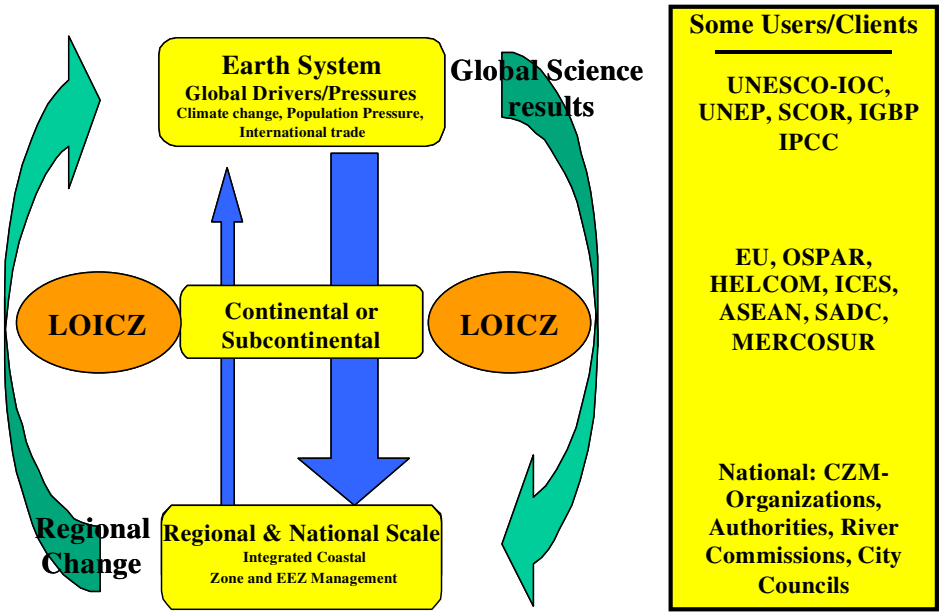
Outputs from all five themes of the LOICZ II will contribute to the curricula of the Water and Coastal Management Masters programmes being developed by ELOISE and help link LOICZ research to the IHDP.

**d) Acquisition**

This second set of cross-cutting activities, dissemination of information and acquisition of data and funds are programmatic but equally vital in the planning and execution of a LOICZ II program. Ensuring interactive information flows between the LOICZ research, mediated by the LOICZ IPO, and the science user or "client' communities underpins our scientific purpose. This raises the question of who are the clients - a question that again involves scaling issues (Figure 1). A purpose of the LOICZ II is to broker a joint ownership of the issues and actions that emerge from the LOICZ outcomes.

The results of regional case studies and of the down-scaling efforts (right green arrow) of global pressures and drivers are directly relevant for regional and national managers and policy makers. The up-scaling efforts (left green arrow) at the continental scale are relevant for authorities, for example in Europe, the European Union and OSPAR. Equally, up-scaling information to the global level is of interest to agencies such as GEF, UNEP, SCOR, UNESCO/IOC and IHP, and the various environmental Conventions, in addition to national policy-makers and coastal managers. It is anticipated that a number of these "clients" will contribute to the wider group of sponsors and as such will contribute importantly to the transfer and awareness of the scientific information. Of course the information exchange will be bi-directional emphasising the need for LOICZ to acquire data from the IPCC and related modelling efforts for its analysis and scaling activities.

Data mining and retrospective analysis will greatly assist these crosscutting activities. Several aspects are not unique to the LOICZ domain and we anticipate drawing on and co-operate with other groups within the Earth System Science Partnership (IGBP, IHDP, WCRP and DIVERSITAS).




*The LOICZ Challenges and its Users/Clients*

Here we have emphasized the direction of benefits that could accrue to various uses of LOICZ scientific results. Equally important is the inward flow of information, advice and collaborative activities from other global and regional research programs that could benefit the LOICZ enterprise. To date LOICZ has built a number of successful partnerships within IGBP and with several international agencies. It is expected that this effort will be maintained and that a close working relationship will be developed with the Earth System Science Partnership of global environmental change programmes (IGBP, IHDP, WCRP, DIVERSITAS) and their integrative projects (currently addressing carbon, food systems, water and, soon, health).

### 5.1.4 Products

Within the 10 years of its second phase besides contributing to Earth system science, LOICZ aims to produce a suite of deliverables and benefits available for management purposes. A key product line in this context will be integrated coastal system change models and interdisciplinary scenarios of change and management options. The scenarios will be tailored to assist the advancement of natural resources management at the river basin scale with a focus on sustainable development in the receiving coastal zone. They will rely on a universal database of natural science and societal information to facilitate integrated coastal zone management. In general the major product lines envisioned are:

- Improved co-ordination and true interdisciplinary cooperation between the natural and social science disciplines allowing holistic evaluation of the thresholds for natural and societal system functioning and the determination of the likelihood that they might be crossed.

- Improved knowledge on vulnerability of coupled human and environmental coastal systems and their use under different change scenarios. This includes risk elements of these scenarios driven by external and internal factors.
- A basin-specific databases encompassing quantitative information on horizontal material fluxes, their drivers and effects including critical loads and thresholds and in particular the land use and institutional dimensions. The extended focus on competitive resource use along the whole water cascade and its effects on coastal system and social sustainability will add considerably to the global relevance of these products.
- A thorough evaluation of shelf processes and their interaction across the land, ocean and atmosphere boundaries recognising large scale and small scale (human) forcing.
- Improved information and databases assisting in the assessment of different forms of coastal (including coastal resource and water) management intervention – their effectiveness and socio-economic cost-benefit relations.
- An advanced typology of world coastal zones and their biogeochemical and socio-economic key parameters on variable scales. This will encompass indicating critical or conflicting states of resource use including recommendations for restoration and subsequent sustainable resource.
- A framework and infrastructure for science dissemination and communication. This includes extension of research results to diverse stakeholder and end-user communities, and communications materials. The collaboration between LOICZ and the IHDP will be vital for reviewing the participatory and communication mechanisms needed here.
- An operational interface of the LOICZ research framework for improving the capacity of the local institutions and the capabilities of the individual people involved to manage effectively the natural resources along the water cascade. This should include the formulation and rationalisation of the development scenarios taking into account the trends in related events and processes as well as stakeholder priorities and concerns.
- Outreach and communication products in form of synthesis reports and peer reviewed scientific publications will be complemented by presentation material, tutorials for methodologies of scientific research, and training in hard copy and supported through electronic publishing on the web site. Specific products can be tailored in cooperation with stakeholders to communicate the relevant results and outcomes to these specific target groups.

### 5.1.5 Stakeholders

Major stakeholders of the LOICZ project are the Earth System Science including the Social Science community policy-making bodies and the various assessment and earth observation efforts as well as private sector bodies focusing on:

- Quantification and predicting coastal change under global change and anthropogenic forcing on local to global scales.
- Development of indicators to assess state and development options for coupled environmental and human coastal systems.
- Identification of quality targets for system state under scenarios of strong and weak sustainability to be built into management policy on relevant institutional scales.
- Development of, and compliance with international conventions.
- Sustainable development and use of coastal zones in recognition of the river basin – coast scale such as the EU, UNEP – GPA and regional and national legislative institutions, training and capacity building institutions, and the private sector.

### 5.1.6 Links with other Programmes

To fulfil this role, a future LOICZ will strongly interact with the International Human Dimensions Programme on Global Environmental Change (IHDP) and within IGBP with the 'Ocean and Land' components. LOICZ will serve within IGBP as the primary interface between the land and marine and water programmes. Outputs from the LOICZ II will contribute to GAIM (Global Analysis, Integration and Modelling) that explores how the dynamics of the Earth System be better understood through modelling studies, the interpretation of the results and of global data. It will work closely also with all Core Projects of IGBP, and build increasing linkages with DIVERSITAS and the World Climate Research Programme (WCRP). The LOICZ II will promote linkages with the integrative projects of the ESSP, namely, the Global Carbon Project (GCP), the Global Environmental Change and Food Systems project (GECAFS) and the new Health initiative and, in particular, the Global Water Systems project (GWSP) that deals with catchment-based hydrological and fresh water resource issues. These links will foster the development, application and communication of Earth System models spanning a range of complexity that integrates across the relevant temporal, spatial and organisational scales the roles and interactions of physical climate, ecological systems, and human systems.

Central though will be the operational links with the IHDP through intensive exchange and joint activities on the development and analysis of integrated data sets and linked models. The LOICZ objective is synergistic and complimentary to the IHDP aims to describe, analyse and understand the human dimensions of global environmental change guided by four overarching questions: **Vulnerability/Resilience**; **Thresholds/ Transitions**; **Governance**; **Learning/Adaptation**?

Specific contextual collaboration for example in the form of task teams is planned also with IMBER (see also their draft science plan in the version of 15 January 2004) and SOLAS, in designing observation and modelling strategies linking coastal to oceanic and atmospheric systems.

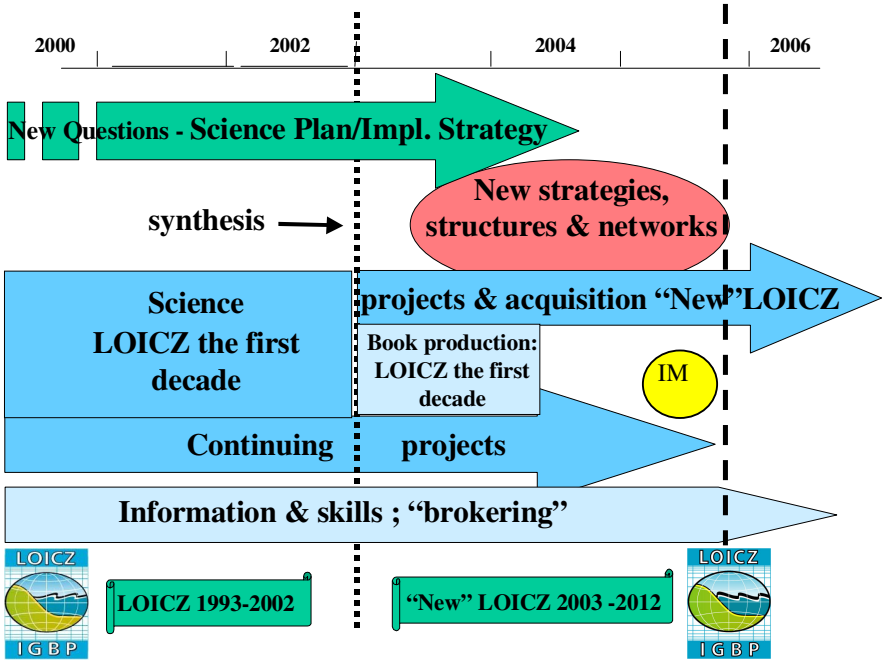
### 5.1.7 Schedule: Transition period 2003-2005

Following the first decade of LOICZ, the IGBP expectation for the lifetime of the second phase continues as far out as 2012. This offers a new dimension for considering the implementation of activities under the "New" LOICZ. The draft new Science Plan (version 30 Jan. 04) bridging between the two phases expands on the priority themes under the future research directions.

Numerous LOICZ projects are continuing beyond 2003 such as the EU-funded EuroCat and daNUbs (European river catchments – Coast interaction; Nutrient management in the Danube Basin and its impact on the Black Sea) DINAS coast, the Dutch funded LOICZ, the EU ELOISE cluster, the biogeochemical assessment synthesis and typology developments (driven by regional and national expert groups) and a number of regional and contributing projects across the world. New projects have been given LOICZ approval in 2003 at local and regional scales, and collaborative working groups been put in place e.g., SCOR, LOICZ, IAPSO WG 122 (see under 3.2).

The central Synthesis work summarising the first decade of collaborative research under the LOICZ program, its findings and gaps has reached the review state in late 2003/early 2004, the preparation of a major book publication is foreseen for late 2004 (see figure below). This will be followed by the production of a brochure under the IGBP Science Series tailored to inform a broader scientific and non-scientific community.

Discussions with potential sponsors to ensure the support funding (initially transitional) have taken place and continue throughout and beyond the transition period. The initial financial support made available from 1 January 2003 for central IPO operations expanding to the end of 2005 allowed for the continued development of the Science plan, continuation and synthesis of running research, initiation of a first set of new research and the restructuring of the IPO and SSC.




*Outline of LOICZ progression. The line at end 2005 indicates the end of the transition period between the "Old" and "New" LOICZ (LOICZ II). IM – Inaugural Science Meeting for the LOICZ II.*

**Schedule**

**LOICZ (First Decade)**

October 2002 — LOICZ Synthesis continues – lead authors meeting

- Early outline LOICZ Synthesis book for IGBP Series

2nd half 2004 — LOICZ Synthesis Book (Springer)

- followed by IGBP Brochure on LOICZ outcomes

**LOICZ II**

September 2002

- Finalise first draft objectives and goals
- Develop draft Themes/Tasks (reflected in a dynamic "Futures Discussion" Doc.)
- Start developing draft Science Plan

**2003 (Transition year 1; Status per early 2004 - all points accomplished)**

- Science Plan outline in the form of a Futures discussion document to IGBP-SC (and other identified sponsors)
- Identification and Invitation of the members for an interdisciplinary scoping team from IHDP to join LOICZ in drafting the Science Plan (first Meeting assoc. to 14th SSC in Banff, Canada, 18 June 2003)
- Draft Science Plan development continues
- Internal review and amendment of Science Plan
- Parallel development of an implementation strategy
- Seek additional sponsor accords and funding for the LOICZ II and IPO Nodes
- Manage existing project activities and promote new opportunities

**2004 (Transition year 2)**

- January, Science Plan and Implementation Strategy draft to IGBP-SC (and seek endorsement from IHDP SC, after additional comments by their extended scoping team) and sponsors for acceptance
- Consolidate and extend structure to implement new Plan (SSC now 25 incl. 4 open slots for IHDP (see under 4), and IPO restructuring towards distributed IPO - ongoing)
- Manage existing project activities and promote new opportunities
- Start of the European and ERASMUS MUNDI Joint Masters in Water and Coastal Management

**2005 (Transition year 3)**

- Inaugural Science meeting for LOICZ II
- Progress review by sponsors
- Extension and consolidation of networks, IPO distribution and new theme activities
- Identification of a new location for the central IPO Node taking effect from January 2006 (seeking support from IGBP, IGFA, international bodies)
- Second edition of the European and ERASMUS MUNDI Joint Masters in Water and Coastal Management

End of transition period "Old" to "New" LOICZ

## 5.2 STRATEGY

**Support and operational structure**
The heart and purpose of LOICZ is scientific research and assessments addressing the agreed objectives and goals of the Core Project and contributing to understanding the role of the coastal zone in Earth function. Operationally, this requires a structure for the scientific networks and activities, along with an accompanying administrative element to assist and co-ordinate the effort.

**IPO**
The IPO will maintain responsibilities comparable to the present situation (LOICZ Implementation Plan 1994 pp. 199-200). However, building on the experience of the first decade 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.

In 2003 LOICZ has continued to progress with the distribution of the IPO. The goal is to accomplish a fully distributed IPO structure by the end of the transition period with a central node for the core administrative and co-ordinating functions and outside reporting joined by a set of about 5 Regional/Thematic IPO Research Nodes. Their task will be to address at least one of the global themes of the New LOICZ science plan and underlying topics with special focus on regional networking and synthesis. Nodes are an expression of national and/or institutional commitment to contribute resources to the implementation of the New LOICZ with mutual benefit for the regional and the global science community. It is also expected that this construction will allow better access to regional support and funding mechanisms and to generate a better ownership and representation of LOICZ science in the region.

Thanks to national support made available in Singapore the first Node has started operation in 2003 and Germany has made preparations to follow in early 2004. This is currently subject to final discussions on formal agreements. These two Nodes are located at the *Environmental Engineering Research Centre* (EERC) of the Nanyang Technological University (NTU), Singapore:


| | |
|---|---|
| Associate Professor ***Lawrence Koe,*** Director | Ms. ***Jasmine Foo,*** Research Executive |
| Environmental Engineering Research Centre | Environmental Engineering Research Centre (Annexe) |
| Nanyang Technological University | Nanyang Technological University |
| Block N1, #B3b-18, | Research TechnoPlaza, Level 5, BorderX Block, |
| 50 Nanyang Avenue, | 50 Nanyang Drive, |
| Singapore 639798 | Singapore 637553 |
| Tel: (65) 6790 4100 | Tel: (65) 6790 5949 |
| Fax: (65) 6792 7319 | Fax: (65) 6791 9394 |
| Email: ccckoe@ntu.edu.sg | Email: cxyfoo@ntu.edu.sg |


and at the ***Institute for Coastal Research***, GKSS Research Centre, Geesthacht (member of the Helmoltz Foundation), Germany,

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Besides these two Nodes others are under consideration with Australia, Africa, Brazil, Sri Lanka* and North America. This is also seen to provide a chance to spread the financial requirements for operations and research synthesis from one nation across several. While this will greatly aid the research actions and regional awareness of LOICZ, it will be a stop-gap approach to meeting the administrative needs in phases in the absence of a sustainable core support for IPO functions. (* The joint APN-SASCOM-LOICZ regional workshop, held in Sri Lanka, in December 2002, to address material fluxes to the coastal zone in South Asia and their impacts finally lead to initial plans and contacts to establish a Regional Thematic IPO Node for South Asia in the country.

The restructuring efforts of the LOICZ SSC and IPO including reconfiguring the operational set up and improving internal and external communications and science dissemination have been made subject to a reader survey that was implemented through the LOICZ newsletter. These will be further addressed in a revised and interactive project data-base and a total revision of the LOICZ website (soon under www.loicz.org). These issues and the SPIS implementation will be key issues in the 15th SSC (2004) where we expect to also welcome our new IHDP colleagues (potential venue – LOICZ IPO Node Singapore).

**SSC**

The SSC will be expanded to a maximum of 25 full Members in order to provide for the appropriate disciplinary and geographical coverage needed to handle an extended and flexible scientific agenda. It will operate on the basis of an *Executive Group* of 7-8 people incl. theme champions, the chair and vice chair and a member likely to be appointed from IHDP. Recognising that core funding from parent program/s will remain on past levels, annual SSC Meetings will invite up to 15 members including the Executive Group (more invitations will be subject to the availability of funds). An additional selection of 7 to 8 SSC Members to reach the 15 can be invited in a flexible fashion. This will allow us to generate the appropriate critical mass of related scientific expertise needed for addressing the priority agenda items. Thus the extended SSC of 25 full Members will provide much better flexibility and improved regional engagement. 4 Members are expected to be recommended by IHDP.

An unlimited group of "Corresponding Members" can be invited upon recommendation of the SSC and those earlier involved can get an "Ex Officio" Status. This new structure has been agreed on at the SSC in consulting with IGBP.

Executive Group

The *Executive Group* will provide guidance to the Chair on planning, development and implementation of the project. It will co-ordinate the functions of the *Scientific Strategy Committee (SSC)*, meet at regular intervals, liaise with and consult the *Corresponding and Ex-Officio Members*. This small co-ordination group will give increased flexibility in coordinating project directions, take responsibility for scientific integration, be adaptable in the light of new questions, address funding issues and assist in "brokering" or communicating information.

Theme Champions will need to be supported by a working group of scientists in planning, implementing and coordinating each research activity and ideally a Project Officer providing administrative and scientific support and liaison to the theme actions. Task work in each thematic area, while addressing the global perspective, would be directed in particular at studying and evaluating at regional scales and would aim to have support from national research funding and actions (see for further detail the recent Futures discussion document.

External to the SSC

LOICZ Members - LOICZ has been and will be existing based on the collective research of a growing group of scientist's worldwide. Those are the PIs of contributing Core, Regional and Relevant projects as well as other contributing experts, involving also academic and non governmental institutions and authorities which maintain informal and/or operational links with LOICZ. This community is expected to grow considerably during the implementation of the LOICZ II in particular through growing involvement of the Human Dimensions Community. Our active partners in these networks will become LOICZ Members. This membership indicates their active contribution and strong interest in the LOICZ work and relation to coastal research and management issues. It will allow us to improve the identity of the network and to enhance the visibility of the invaluable contributions of all the people and institutions contributing to the LOICZ Project.

## 6. COLLABORATION

As flagged in section 4.2 during the IGBP Congress in Banff, June 2003, LOICZ has been more or less directly contributed to or taken the lead in various working groups: this engagement has led to a number of follow up activities to which LOICZ contributed, namely, the further development of the IMBER science plan including arrangements for two way collaboration, *dito* with SOLAS and LOICZ participated in the Data Management workshop in late 2003 supported by SCOR. Follow up issues will be addressed during the upcoming 15th SSC in the context of the first steps of the LOICZ II implementation.

Further to that, the engagement with IHDP representatives during the SSC scoping team and during the Banff WGs, for instance on vulnerability and between LOICZ with GLOBEC and GECAFS, has further nourished earlier plans to set up a joint IHDP, ESSP, LOICZ coastal panel at the HD Open Meeting in Montreal in October 2003. This panel "Global Environmental Change and Coastal Systems: A Microcosm of Coupled Human-Environmental Systems" was the first joint activity involving GECHS, GLOBEC, IDGEC and IGBP-LOICZ and has agreed on a few key questions that will be addressed in a joint publication effort starting 2004 (see section 4.2).

In addition LOICZ has continued to actively seek collaboration throughout 2003, building on and extending earlier relationships both internally in the IGBP "family" and recently the Earth System Science Partnership, ESSP, and externally with international agencies and science "users". The extended global network of scientists associated with LOICZ is the heart of the project. The LOICZ network has been sustained and more than 2500 people and key agencies are involved in the activities and science delivery.

A major element of the project is the support provided through national governments and their research agencies and universities, often involving a national LOICZ representative or sub-committees associated with a national IGBP Committee. Many research actions and projects are developed and implemented through these arrangements, and outcomes contribute to thematic and regional synthesis work of the LOICZ program.

In 2003, the Dutch research agencies continued funding research proposals as components of a national LOICZ project cluster with a total of US$3.5 million over three years (2002-2005). A second call was launched. Germany launched an initiative supporting two major project clusters dealing with science for coastal zone management, which address transboundary catchment–coast interaction and human dimension issues as well as windparks and other uses in protected areas. Both are also aimed to identify and build interdisciplinary networks of scientists and institutions. This networking and participatory approaches are research issues. The funding will start in 2004 and is in the order of 4 Million € in total for an initial period of 3 years. Both clusters will be linked to LOICZ and ideally support parallel efforts to establish a German IPO Research Node. The latter initiative comprises, besides the potential host GKSS, all relevant German institutions dealing with coastal and marine research.

Major regional programmes are also part of LOICZ, including projects with varying degrees of integration which provide regional assessments of the LOICZ key questions. There has been continued opportunity and collaboration in this area during 2003. The EU supported DINAS Coast projects (see Section 3.3) deals with integrated modeling of coastal vulnerability in different change scenarios. The European Basins study, EuroCat, was extended by another set of two full-scale national research sites in Bulgaria and Slovenia with funding from the European Union, and LOICZ has become engaged with daNUbs. The implementation of the Russian LOIRA project has gained continued support from IASC in particular, and from other polar research funding sources including NSF.

Collaborative actions within the EU-funded ELOISE program are providing regional and thematic research outcomes and the ELOISE synthesis has gained full thrust through the secretariat and a scientific consortium that gained approval to operate for a second year. The involved institutions work closely with LOICZ on an international and national level.

LOICZ continues building an association with UNEP and other global programs. The Basins task in LOICZ is a catalyst in this arena, with the AfriBasins process (2000/2001) cumulating in a new AfriCat pilot project supported by START, IOC and LOICZ. Following initial communication between the IPO and the UNEP EO in this context, UNEP has asked its GPA programme office to establish a formal link with LOICZ. This is in the area of integrated coastal and river catchment management and has been extended until late 2003 to the Freshco partnership of related stakeholders. UNEP GPA and LOICZ will collaborate in the process of establishing ICARM pilot sites and in the AfriCat project.

In 2003 initial links to UNESCO/IHP have been consolidated. A joint proposal with IHP was submitted to UNESCO internally dealing with an extension of AfriCat but had to be resubmitted at the end of 2003. First concrete support came in the AfriCat synthesis effort and LOICZ in reverse supported the Coastal session of the IHP in the Kyoto WWF3. We are expecting that this collaboration has potential to grow and be expanded to other IHP related projects such as HELP. Interest to support continued LOICZ research on groundwater issues has also been indicated by UNESCO/IHP and options are under exploration by the IPO.

Within IGBP, LOICZ has continued extended consultation with the Global Water Systems Project (GWSP), which developed from initial plans for a Joint Water Project, under the four Earth System Science partners. This is seen to be a major collaborator although interfaces have to be developed cautiously and sensitively because of considerable potential for overlap. Additional contributions to the cross-cutting projects of the ESSP (IGBP, IHDP, WCRP and DIVERSITAS) have been made to the Food Systems Project (GECAFS) by drawing on networks and results from the LOICZ CariBasins assessment, and to the Global Carbon Project through consultation during its Science Plan development.

LOICZ highly values its close working relationship with the START project on capacity building and regional assessment. Training in regions has continued in the form of the pilot project, AfriCat, and through LOICZ involvement in the considerations of future scientific agendas for regional studies in Monsoonal Asia and Northeast Asia. The joint APN-SASCOM-LOICZ workshop to address coastal material fluxes in South Asia (December 2002) was another milestone in a collaborative journey started in 1999. It has generated some synthesising work in the region results of which will be summarized in a report expected in 2004. LOICZ is expecting to further develop its close collaboration with START.

In principle, initiatives and the collaborative contacts and funding with other agencies pursuing capacity building projects (e.g., IOC, the Inter American Institute for Global Change, IAI, the Asia Pacific Network for Global Change, APN) continue to provide efficiency and valuable outcomes from joint ventures. In 2003 LOICZ has particularly intensified its collaborative links with the IAI through participation in the IAI General Meeting in January together with IGBP and through supporting the development regional proposals that will help developing scientific agendas along with LOICZ II in Latin America. In Asia/Pacific LOICZ scientists have taken the lead in guiding a synthesis of the APN supported coastal research initiatives with will be carried on into 2004.

The traditionally close association with the SCOR global program has seen a major push in 2003 following the SCOR General Meeting decisions to become a co-sponsor of LOICZ. However, in contrast with GLOBEC and JGOFS their support for LOICZ will be subject to acquisition of funds mostly from US agencies. The recent year has proven that this is not a trivial task but irrespectively SCOR has been able to provide invaluable support to LOICZ in

the areas of capacity building and in assisting the collaboration with other global change partners. Namely LOICZ's involvement in the discussions on data needs and management have been supported by SCOR. A concrete scientific issue will be addressed jointly through establishment of the Working Group on "Mechanisms of Sediment Retention in Estuaries" lead by Gerardo M.E. Perillo and Björn Kjerfve with the participation of James Syvitski. SCOR and LOICZ supported by IAPSO agreed to provide a basic funding for a global assessment and synthesis for this group for three years 2004-2006.

A major goal for LOICZ is to ensure that the scientific research is made available to coastal zone managers and policy makers. LOICZ has sustained a strong and close working association with the Intergovernmental Oceanographic Commission (IOC), and continues to develop accords with other international bodies that can act as science "brokers", such as the European Commission, UNESCO IHP, and the Global Program of Action on Land Based Sources GPA (UNEP).

With IOC, a focus since 1998 has been towards joint actions and consultation on integrated coastal area management (ICAM), developments of the coastal-GOOS plans (now COOP), and capacity building in world regions. In 2003, this close collaboration was extended further into synthesis of regional basins activities (AfriCat). Following the final approval of the new SPIS IOC and LOICZ are planning to revisit their formal agreement for collaboration signed in 1994 and investigate options for enhanced collaborative activities.

A collaborative link has been maintained with the RIKZ, The Hague, although the liaison relation with the Costal Management Unit terminated at the end of 2002. RIKZ also agreed on an initial one year extension of funding for IPO operations in the year 2003. It is envisioned that with the new SPIS in place the applied science element deriving from LOICZ will provide an even broader platform for collaboration including for instance exchange of information in the area of ecosystem indicator development.

As pointed out in section 4.4, particular efforts have been directed towards improved involvement of developing economy regions. Strengthening the regional collaboration and institutional networking is seen to facilitate the necessary data and information exchange and lead to internal and cross-regional flow of expertise and capacity building. LOICZ wants to support this structurally and provide the platform for regional scientists to play a leading intellectual role here. This means, *inter alia,* targeted efforts by LOICZ to be responsive in mentoring and support for scientists especially in developing economies, and aiding in addressing topics where International Conventions oblige countries to take action (e.g., Climate Convention, Biodiversity Convention, Wetlands Convention). The Climate Convention (UNFCCC) for example, involves effects of sea-level rise, $CO_2$ and methane emissions. LOICZ may take on the role of an active partner in the Conventions, helping to foster political will and financial support to resource necessary scientific efforts directly or via regional "aid" organisations. This should have potential generally to advance LOICZ's networking and information transfer.

The establishment of "Regional/Thematic IPO" Research Nodes and the instrument of "corresponding member to the SSC" are expected to add strongly to the role LOICZ can play in these regions by advancement of networking, funding and providing an institutional focal point for the regional science efforts. A fully implemented communication strategy will be a pivotal element in accomplishing this goal and making LOICZ also a provider of scientific information in a relevant form.

## 7. COMMUNICATION

Personal contacts from workshops and LOICZ integrative activities are a key part of the interactions between "members" of the LOICZ community. However, communication within and beyond LOICZ is also vital for the effectiveness and success of the project. Increasingly we are meeting these needs through electronic media – websites and interactive e-pages, a network of email contacts, and transfer of information. We recognise that people are our key resource and that, while electronic media provides for broad contacts, not all scientists and science-users have the same level of access. Hence, LOICZ tries to disseminate information by a mix of printed and electronic publications.

In 2003 a major reader survey among the 2500 colleagues listed in the LOICZ database has been carried out to assist the IPO in enhancing the effectiveness of its communication and outreach. With a little less than 30 % response, we received an overview of who the active members are and how best to rearrange the publishing of our communication media. As a result, taking effect in 2004 there will be considerably less hard copies of the Newsletter to be produced while electronic mailing will increase. We decided to keep the database but limit our active mailing to those who have responded in the course of the survey. However, agencies and institutions will not be affected and are kept in the active list. This will enable LOICZ II to start with an updated database of active members and allow us to include the growing number of new scientists who wish to take part in LOICZ. In particular we expect that there will be a growing group of social scientists wishing to be included since LOICZ from 2004 onwards will be co-sponsored by the IHDP.

In general in 2003, LOICZ has continued to use a mix of media to spread its research findings and to promote the network of players, internally and with users.

**Newsletter**
Four editions of the LOICZ Newsletter (No. 26-29) were produced and each was distributed to about 2500 people and agencies. Generally, each Newsletter contained one to two scientific articles, news and updates on LOICZ and related project activities and key publications and a calendar of relevant meetings and workshops within and associated with the project. We also used the NL to introduce the new SSC members and Nodes to the wider LOICZ community.

**LOICZ and related websites**
The LOICZ website (www.nioz.nl/loicz/) has been replaced at the end of the year by a new one under (www.loicz.org). This was due to a restructuring in NIOZ internally. We will use this opportunity to revise the old web site and improve its information capacity and fit to LOICZ II. This process is ongoing and currently the new address mainly links the reader to the old site. Copies of new LOICZ printed materials are available through the site, links are provided to other coastal science sites, and new publications are listed which deal with coastal research and coastal zone management.
The website so far provides limited access to LOICZ databases and full download access to tools, especially for biogeochemical budgets, typology, basins and deltas management project. However, here we are planning for improvement in 2004:

**The project database**
In the future we expect to establish an interactive LOICZ project database (core, regional and relevant projects) which is aimed to allow the PIs to have a password protected access. This will keep this invaluable source of information a lot more effective, user friendly and useful for the general science community. LOICZ will ask associated projects to provide updates of their status and publications and products at least half annually: Collaboration with EUCC is foreseen in this area.

Links are made to additional thematic web-pages e.g., SURVAS, DINAS. The list below contains some of the most relevant web sites for LOICZ work:

LOICZ home page: http://www.loicz.org leading currently to http://www.nioz.nl/loicz

LOICZ Biogeochemical Modelling and Budgets: http://data.ecology.su.se/MNODE

LOICZ Typology and Scaling: http:/www.kgs.ukans.edu/Hexacoral/Workshops
http://palantir.swarthmore.edu/~maxwell/loicz

LOICZ River Basins: http://w3g.gkss.de/projects/loicz_basins/

Deltas Management: http://www.deltasnetwork.nl

SURVAS: http://survas.mdx.ac.uk

South Asia Coastal Fluxes: http://www.coastal-fluxes.slt.lk as of June 2004 has been replaced by http://www.nsf.ac.lk/slaas/cfweb

DINAS: http://www.PIK-Potsdam.DE/~richardk/dinas-coast/

ELOISE: http://europa.eu.int/comm/dg12/eloise/eloise-h.html
secretariat http://www.nilu.no/projects/eloise

**(for additional web-links in particular to the typology and database activities you are kindly referred to the detailed outlines and background given in section 3.2)**

**Publications**

2003 special journal publications, books (in preparation) and thematic publications have been incorporated into peer-reviewed literature (see table below and publication list).

**Summary of LOICZ publications**

(**A** – active; **C** – commenced**.** ( )*** -** in preparation. # - publications from about 50% of projects and contained in LOICZ database. na – not available)

| | **1999** | **2000** | **2001** | **2002** | **2003** |
|---|---|---|---|---|---|
| | | | | | |
| **LOICZ Newsletter** | 3 | 4 | 4 | 4 | 4 |
| | | | | | |
| **LOICZ Reports and Studies (incl. CD ROMS)** | 2 | 3 | 4 | 8 (1)* | (3)* |
| | | | | | |
| **Open Science Meetings** | 1 | | | 1 | |
| | | | | | |
| **Websites** | | | | | |
| LOICZ | A | A | A | A | A |
| Biogeochemical budgets & Modelling | A | A | A | A | A |
| South Asia Coastal Fluxes | | | C | A | |
| Sea Level (SURVAS) and DINAS Coast | C | A | A | A | A |
| Typology Database and Tools | | C | A | A | A |
| River Catchments & Basins | | C | A | A | A |
| Deltas | | C | A | A | A |
| ELOISE | | A | A | A | A |

**Summary of LOICZ publications (continued)**

| | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| | | | | | |
| **Publications** | | | | | |
| Books | 2 | | 3 | 1(1)* | (3)* |
| Special issue peer journals | 1 | | 3 | 1 (3)* | 2 (1)* |
| Key peer publications | 8 | 7 | 4 | 8 (1)* | 1 (3)* |
| Contributed projects peer publications# | 151 | 107 | 88 | na | na |
| | | | | | |
| **Software & Manuals** | | | | | |
| CABARET – Budget estimation program (web) | 1 | | | | |
| LOICZ Biogeochemistry Procedures | | 1 | | | |
| Budgeting and modelling tools (web) | | 4 | | | |
| Typology tools and databases (web) | | 1 | 1 | | |
| Basins assessment methods (web) | | | 1 | | |
| DINAS Coast – DIVA(Vulnerabilty indicator assessment tool) | | | | | 1 |

## Publication List 1999-2003

Because of its focus on fundraising, restructuring of the IPO and SSC and in particular on developing the Science Plan and Implementation Strategy the LOICZ IPO in 2003 had a reduced output in scientific publications (though various R&S reports are in their final stages before publishing). Another reason was and still is the work on the LOICZ (I) Synthesis book, which has attracted considerable effort of the Focus and theme leaders. LOICZ scientists, however, have maintained a strong output of publications and special issue journals. Recent material is usually backed by CD-ROM data and additional information and all LOICZ R&S and Newsletter publications are contained on the LOICZ website. It is expected that the new website will evolve as a major platform for featuring publications of LOICZ science and that an interactive project database will allow the reader to more easily access the project – based references.

**LOICZ: List of key publications (1998-2002)**

| | LOICZ Reports and Studies | | Date |
|---|---|---|---|
| **No.** | | | |
| **11** | Towards Integrated Modelling and analysis in Coastal Zones: Principles and Practices | 122 pp. | 1998 |
| **12** | Australasian Estuarine Systems: Carbon, Nitrogen and Phosphorus Fluxes | 182 pp. | 1999 |
| **13** | Mexican and Central American Coastal Lagoon Systems: C,N & P Fluxes | 115 pp. | 1999 |
| **14** | Estuarine Systems of the South China Sea Region: C,N & P Fluxes | 156 pp. | 2000 |
| **15** | Estuarine Systems of the South American Region: C,N & P Fluxes | 87 pp. | 2000 |
| **16** | Estuarine Systems of the East Asia Region: C,N & P Fluxes | 127 pp. | 2000 |
| **17** | Biochemical and Human Dimensions of Coastal Functioning and Change in South East Asia | 165 pp. | 2001 |
| **18** | Estuarine Systems of Sub-Saharan Africa: C,N & P Fluxes | 83 pp. | 2001 |
| **19** | Coastal and Estuarine Systems of the Mediterranean and Black Sea Regions: C,N & P Fluxes | 101 pp. | 2001 |

| | LOICZ Reports and Studies | | Date |
|---|---|---|---|
| | | | |
| **20** | Estuarine Systems of Africa (Regional Workshop II):C,N & P Fluxes | 81pp | 2002 |
| **21** | South American BASINS: LOICZ Global Change Assessment and Synthesis of River Catchment – Coastal Sea Interaction and Human Dimensions | 212 pp. | 2002 |
| **22** | LOICZ/UNEP Regional Synthesis Workshops: Australasia-Asia, the Americas, Africa-Europe. Summary Report and Compendium | 77 pp., incl. CD ROM | 2002 |
| **23** | Estuarine Systems of the Latin American Region and Estuarine Systems of the Arctic Region: C,N & P Fluxes | 103 pp. | 2002 |
| **24** | The role of the coastal zone in the disturbed and undisturbed nutrient and carbon cycles | 83pp, incl. CD ROM | 2002 |
| **25** | African BASINS: LOICZ Global Change Assessment and Synthesis of River Catchment – Coastal Sea Interaction and Human Dimensions | 306 pp. | 2002 |
| **26** | East Asia BASINS: LOICZ Global Change Assessment and Synthesis of River Catchment – Coastal Sea Interaction and Human Dimensions | 226 pp. | 2002 |
| **27** | Caribbean & Oceania BASINS: LOICZ Global Change Assessment and Synthesis of River Catchment – Coastal Sea Interaction and Human Dimensions | 174 pp. | 2002 |
| **28** | Russian Arctic BASINS: LOICZ Global Change Assessment and Synthesis of River Catchment – Coastal Sea Interaction and Human Dimensions | | In preparation (publ. summer 2004) |
| **29** | South Asian Estuaries and Basins | | In preparation |
| | | | |
| | | | |
| | *Journals and Special Issue Journals* | | |
| | Science of the Total Environment - LOIS Vols. 210/211 | | 1998 |
| | American Zoologist- Coral Reefs and Environmental Change Vol. 39 | | 1999 |
| | Journal of Sea Research - LOICZ Vol. 46 (2) | | 2001 |
| | Science of the Total Environment - LOIS | | 2001 |
| | Sea to Air transport of trace gases in the coastal zone: a literature review; Pacyna J. & Oystein H, REC, Springer, Vol 2 | 15 pp. | 2002 |
| | Regional Environmental Change – LOICZ | | 2002 |
| | River catchment–coastal sea interaction and human dimensions, Regional Environmental Change, Springer, Vol. 4, No 1 | | 2003 e-pub. 2004 hard copy |
| | Submarine Groundwater Discharge: Its Measurement, Modelling and Globalisation; Biogeochemistry Vol 66 1-2 | 202 pp | 2003 |
| | Supply and Flux of Sediment along Hydrological Pathways: Anthropogenic Influences at the Global Scale; Global and Planetary Change Vol 39 Nos. 1-2 | 199 pp | 2003 |
| | Sea Level Changes – SURVAS | | In preparation |

| | | | |
|---|---|---|---|
| | **Books** | | |
| | Scientific Report on Socio-economic Aspects of Fluxes into the Marine Environment. Pacyna, J.M., Kremer, H.H., Pirrone, N and Bartherl, K.G., eds. EU Monograph Series EUR 19089. EU Commission, Brussels | | 1999 |
| | Perspectives on Integrated Coastal Management. Salomons, W., Turner, R.K., de Lacerde, L.D. and Ramachandran, S., eds. Springer, 386pp + CD-ROM. | | 1999 |
| | 85th Dahlem Workshop on Science and Integrated Coastal Management. Dahlem von Bodungen, B and Turner, R.K., eds. University Press, Berlin, 378pp. | | 2001 |
| | Managing a Sea: The Ecological Economics of the Baltic. Gren, I.m., Turner, R.K. and Wulff, F. Earthscan Publications Ltd., London, 138pp. | | 2001 |
| | A Systems Analysis of the Baltic Sea. Wulff, F.V., Rahm, L.A. and Larsson, P., eds. Ecological Studies 148, 455pp. Springer, Berlin | | 2001 |
| | Managing European coasts: past, present and future, (ELOISE) Springer | | In preparation |
| | CMTT Synthesis | | In preparation |
| | LOICZ (I) Synthesis | | In preparation |
| | | | |
| | **LOICZ II** | | |
| | Science Plan and Implementation Strategy | | Under review |
| | | | |
| | **Key Thematic Research Paper** | | |
| | Listed in LOICZ Annual Reports (1998-2002; 2003 in prep.) | | |

Numerous scientific publications have been produced from research projects contributing to LOICZ Core, Regional and Relevant Research projects – research papers, special issues of peer-reviewed journals and a number of books, technical reports and thematic workshop proceedings. Those include assessment, presentation of research findings and materials, the preparation of scientific publications in a number of journals and for a variety of meetings held by related agencies addressing coastal research and in the transfer of scientific knowledge to coastal managers, policy and industry sectors. LOICZ also publishes the Reports & Studies series encompassing regional integration of thematic issues, usually derived from workshops. Most recent publications are usually listed in the LOICZ Newsletter. In parallel a number of contributions and presentations where given on various occasions for example many of those listed under Section 4.3. They are not listed here in detail but publications and training efforts shown above capture most of their scientific content.

## 8. FUNDING

**IPO and Operational Activities**

LOICZ has spent considerable time and effort trying to garner the financial underpinning of its IPO for 2003+, seeking a variety of national and agency sponsorships. While after an extended period of uncertainty funding for core IPO functions has ultimately been secured, through the generous support by the Netherlands Science Foundation, NWO, the RIKZ, and the Dutch Climate Research programme under the VROM, it still holds that difficulties in obtaining operational funds are increasing rather than decreasing. The positive decision by the Dutch funders and Royal NIOZ (providing in kind support for the IPO) can be attributed to the review of IPO operations undertaken by their independent international panel in 2002 followed up by intensive fundraising efforts by the Chair, the IPO and in particular NOW. The panel had recommended a further 3 year support for the IPO at an even greater level than proposed by the LOICZ SSC/IPO. Approval of this proposal has finally allowed us to bring the IPO staff back to at least three full time appointments including a new Deputy Executive Officer who joined in January 2004.

Another observation is that funding for research actions and workshops can increasingly be found though some creativity – increasingly challenging and fast growing demands for complex scientific answers are opposing increasingly conservative national and regional research budgets and global political challenges. It seems particularly pivotal to identify mechanisms that allow a consolidated operation of the theme leaders in their efforts to guide and coordinate the research topics under each theme. While this had been possible in the past in the typology and biogeochemical research case other activities had to struggle to ensure even basic support for focus coordination. LOICZ II will need to give priority attention to this issue since there is the expectation that scientific delivery will be in a relatively shorter sequence than in the past. The IPO and SSC are asked to seek options to find this token support for effective theme coordination and synthesis.

The other key issue where there is still a need for investigating mechanisms catering for a long-term consolidation of funding for IPO basic operations should be addressed with growing priority by the IGBP and in general by mother and sponsoring programs. In the LOICZ case the central IPO has to move after 2005 calling for a targeted and strong effort to seek an appropriate national or institutional commitment to host the central node, a constraint which has already been made brought to the attention of IGFA.

Encouraging was the fact that already two institutions in Singapore and Germany have either begun to commit funds and in kind support to the LOICZ IPO operations or indicated their strong intention to start soon in 2004. This will be a major push for the IPO operations since we consider the budget dedicated to the Regional and Central Nodes as a single asset contributed in support of IPO operations. In both cases the commitment includes some discretional support also for research activities. We are optimistic that this development can be continued throughout the rest of the transition period and beyond.

Less encouraging was that fact that the SSC and IPO for all sorts of reasons haven't made substantial progress in identifying and accessing foundation and private sector support. Although initial inquiries seemed to be not entirely promising it is a given that these efforts have been largely on low rather than appropriate profile. The time commitment is an obvious driver for this problem. It is an urgent need that SSC and IPO in the future will put more attention and effort on these activities and we hope that an approved science plan and implementation strategy will be a good underpinning to showcase the value adding potential LOICZ can provide to fundamental and applied coastal global change science. A true interdisciplinarity with the human dimensions disciplines seems an additional selling point

although ways for successful stakeholder involvement and continued participation, which are critical in this context, have yet to be identified.

As far as scientific implementation and broadening the funding base for LOICZ research is concerned a major step forward was the official approval by the SCOR General Meeting to become a thematic sponsor of LOICZ. Their support will concentrate on the natural science aspects of estuarine and shelf processes. While it has turned out to be challenging to raise the related funds, SCOR has already been actively supporting the LOICZ work in the calendar year 2003 for instance by funding participation of young scientists in a joint LUCC, NASA LOICZ meeting on remote sensing in coastal zones and global change, and arranging for LOICZ participation in the Data management workshop (see also section 6).

In addition to this major streams of funding for the IPO, research activities and continued support of the research project from the Netherlands government, in 2003 LOICZ gained significant funding for targeted activities from various organisations, namely from IAI, IGBP, IOI, UNESCO/IOC, IHP, NORAD (through START) and others. This funding includes targeted regional activities and capacity building. The European Union has provided continued and major support funding for the suite of ELOISE projects.

In-kind support, beyond the one coming from NIOZ, and many national government agencies continues to underpin LOICZ activities. It is provided by a variety of universities and national institutions and constitutes a vital core research support contributing in particular to those efforts that bridge between the old and new LOICZ and faced some hiatus in LOICZ support during the transition. This applies for example to CICESE, the Universities of Kansas, Maryland and Stockholm, NILU (Norway), Boulder Colorado, IVM Amsterdam and GKSS (Germany).

In addition, national and international agencies support an extensive number of the Regional and Relevant Research projects (listed in Sections 3 and 6); these financial contributions are not included here.

Beyond 2003: since the IHDP in early 2004 decided to become a co-sponsor of the LOICZ II one may expect that there will be additional opportunities for fundraising in the future, where IHDP and LOICZ experts can collaborate in exploring and accessing new resources. However this will take time and is not expected to be fully up to speed until after the transition period. The same applies to the Regional Thematic Nodes, at least some of which may initially need token support to come into full operation. In the mid-term, however, LOICZ may benefit form this improved access to regional networks and funding sources.

In principle, core funding for the future LOICZ is directed to the project as a whole. Core funding and in-kind contributions will provide the support for each node (staff, operations) and the thematic and wider integration work of the future LOICZ program. IPO research node locations reflect national sources of major core funding and act as key regional centers for wider operations.

The estimated income funding stream for core operations LOICZ (including cash and in-kind to IPO only) in the years 1999 - 2003 in EURO is listed below.

| | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| **LOICZ Phase 1 and beginning Transition (1999-2003)** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Transition Year 1** |
| | | | | | |
| **Cash** | | | | | |
| Core support | 403 200 | 406 800 | 405 500 | 406 200 | 379 000 |
| Additional support | 198 300 | 353 300 | 356 100 | 141 000 | 166 000 |
| subtotal | 601 500 | 760 100 | 761 600 | 547 200 | 545 000 |
| **In kind** | | | | | |
| NIOZ and RIKZ* (* = not applicable in year 2003) | 118 200 | 118 200 | 118 200 | 118 200 | 50 000 |
| Additional support | 245 400 | 328 600 | 336 400 | 314 900 | 180 000 |
| subtotal | 363 600 | 446 800 | 454 600 | 432 900 | 230 000 |
| | | | | | |
| **TOTAL** | **965 100** | **1 206 900** | **1 216 200** | **980 100** | **775 000** |
| | | | | | |

## ABBREVIATIONS LIST

| | | |
|---|---|---|
| ACD | - | Arctic Coastal Dynamics project |
| ACOPS | - | Advisory Committee on Protection of the Sea |
| AfriCat | - | African Catchments |
| AGU | - | Americal Geophysical Union |
| AIST | - | National Institute of Advances Industrial Science and Technology |
| APN | - | Asia Pacific Network |
| ASEAN | - | Association of South East Asian Nations |
| ASLO | - | American Society of Limnology and Oceanography |
| AWI | - | Alfred Wegener Institut für Polar- und Meeresforschung |
| BAHC | - | Biospheric Aspects of the Hydrological Cycle (IGBP core project) |
| CABARET | - | Computer Assisted Budget Analysis for Research, Education, and Training |
| CARICOM | - | The Caribbean Community and Common Market |
| CICESE | - | Centro de Investigacion Cientifica y de Educacion Superior de Ensenada |
| CMTT | - | Continental Margins Task Team (joint LOICZ and JGOFS project) |
| C,N & P Fluxes | - | Carbon, Nitrogen and Phosphorus |
| COOP | - | Coastal Ocean Observations Panel (UNESCO/IOC) |
| CRC | - | Cooperative Research Centre |
| CSERGE | - | Centre for Social and Economic Research on the Global Environment |
| CSIRO | - | Commonwealth Scientific & Industrial Research Organisation |
| CZ | - | Coastal Zone |
| CZM | - | Coastal Zone Management |
| CZMC | - | Coastal Zone Management Centre |
| DaNUbs | - | Nutrient Management in the Danube Basin and its Impact on the Black Sea |
| DiGIR | - | Distributed Generic Information Retreval |
| DINAS-COAST | - | Dynamic Interactive ASessment of National, Regional and Global Vulnerability of COASTal Zones to Climate Change and Sea-Level Rise |
| DISCO | - | Gespatial clustering tool (successor of LOICZView) |
| DIVA | - | Dynamic Interactive Vulnerability Assessment tool (in DINAS Coast) |
| DIVERSITAS | - | An International Programme of Biodiversity Science |
| DPSIR | - | Drivers-Pressure-State-Impact-Response framework |
| EERC | - | Environmental Engineering Research Centre |
| EEZ | - | Exclusive Economic Zone |
| EGS | - | European Geophysical Society |
| ELOISE | - | European Land-Ocean Interaction Studies |
| ERA | - | European Research Area |
| ERF | - | The Estuarine Research Federation |
| ESSP | | Earth System Science Partnership of IGBP, IHDP, WCRP & DIVERSITAS |
| EU | - | European Union |
| EUCC | - | The Coastal Union |
| EUG | - | European Union of Geoscience |
| EuroCat | - | European Catchments |
| EXCOMM | - | Executive Committee |
| GAIM | - | Global Analysis, Integration and Modelling |
| GCP | - | Global Carbon Project |
| GEC | - | Global Environmental Change |
| GECAFS | | Global Environmental Change and Food Systems (of the ESSP) |
| GECHS | - | Global Environmental Change and Human Security |
| GEF | - | Global Environment Facility |
| GIS | - | Geographical Information Systems |
| GKSS | - | GKSS Research Centre, Germany |
| GLOBEC | - | Global Ocean Ecosystem Dynamics |
| GOOS | - | Global Ocean Observing System |
| GPA | - | Global Programme of Action for the Protection of the marine Environment from Land-based Activities |
| GWSP | - | Global Water Systems Project (of the ESSP) |
| HELCOM | - | Baltic Marine Environment Protection Commission (Helsinki Commission) |
| HELP | - | Hydrology for Environment, Life and Policy (of UNESCO) |
| IAEA | - | International Atomic Energy Agency |

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| IAI | - | Inter America Institute |
| IASC | - | International Arctic Science Committee |
| IAHS | - | International Association of Hydrological Science |
| IAPSO | - | International Association for the Physical Sciences of the Oceans |
| ICAM | - | Integrated Coastal Assessment and Management |
| ICARM | - | Integrated Coastal Area and River Basin Management |
| ICES | - | International Council for the Exploration of the Sea |
| ICSU | - | International Council of Scientific Unions |
| IDGEC | - | Institutional Dimensions of Global Environmental Change |
| IGBP | - | International Geosphere-Biosphere Programme |
| IGFA | - | International Group of Funding Agencies for Global Environmental Change |
| IGOS | - | Intergovernmental Organizations |
| IHDP | - | International Human Dimensions Programme on Global Environmental Change |
| IHP | - | International Hydrological Programme (UNESCO) |
| IKONOS | - | An earth imaging satellite |
| IKZM | - | Integriertes Küstenzonenmanagement (Integrated Coastal Zone Management) |
| IMBER | - | Integrated Marine Biogeochemistry and Ecosystem Research (IGBP/SCOR) |
| INCO | - | Cooperation with third countries and international organizations (International Cooperation) EU programme |
| IOC | - | Intergovernmental Oceanographic Commission of UNESCO |
| IPCC | - | Intergovernmental Panel on Climate Change |
| IPO | - | International Project Office |
| IT | - | Industrial Transformation (IHDP) |
| ITU | - | Istanbul Technical University |
| IUGG | - | International Union of Geodesy and Geophysics |
| IUGS | - | International Union of Geological Sciences |
| IVM-VU | - | Instituut voor Milieuvraagstukken-Vrije Universitteit (Institute for Environmentasl issues –Free University) |
| INQUA | - | International Union for Quarternary |
| JGOFS | - | Joint Global Ocean Flux Study (IGBP core project)) |
| JRC | - | Joint Research Centre (EU Com.) |
| KGS | - | Kansas Geological Survey |
| KNAW | - | Netherlands National Academy of Sciences |
| LANDSAT | - | US satellite for remotly sensed imaging of the earth surface and coastal zones |
| LDC | - | Linguistic Data Consortium |
| LOICZ | - | Land-Ocean Interactions in the Coastal Zone (IGBP core project) |
| LOIRA | - | Land-ocean Interactions in Russia |
| LOIS | - | Land-Ocean Interaction Study, United Kingdom |
| LUCC | - | Land-Use Cover Change (IGBP core project) |
| MADAM | - | Mangrove Dynamics and Management, (Project based at Zentrum für Marine Tropenökologie, Bremen, Germany) |
| MAST | - | Marine Science and Technology |
| MERCOSUR | - | Mercado Común del Sur (Argentina, Brasil, Paraguay y Uruguay) |
| MMD | - | Modified Mega Deltas |
| MODIS | - | Moderate Resolution Imaging Spectroradiometer |
| MoU | - | Memorandum of Understanding |
| MSP | - | Medium-Size Project |
| NASA | - | National Aeronautics and Space Administration |
| NBII | - | National Biodiversity Information Initiative |
| NEPAD | - | The New Partnership for Africa's Development |
| NILU | - | Norwegian Institute for Air Research, Oslo |
| NIOO-CEMO | - | Netherlands Institute of Ecology-Centre for Estuarine and Marine Ecology |
| NIOZ | - | (Royal) Netherlands Institute for Sea Research, Texel |
| NOAA | - | National Oceanic and Atmospheric Administration |
| NORAD | - | Norwegian Agency for Development Cooperation |
| NSF | - | National Science Foundation, USA |
| NTU | - | Nanyang Technological University |

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| NWO | - | Netherlands Organization for Scientific Research |
| OBIS | - | Ocean Biogeographic Information System |
| OSM | - | Open Science Meeting (e.g., LOICZ OSM4, Argentina) |
| OSPAR | - | Oil Spill Preparedness and Response project of ASEAN |
| PACOM | - | Pacific Communications |
| PAGES | - | Past Global Changes (IGBP core project) |
| PASS | - | Pan African START Secretariat |
| PI | - | Principal Investigator |
| PNEC | - | Programme National sur l'Environment Côtier |
| POFLECS | - | Processes of Ocean FLux in the East China Sea |
| RIKZ | - | Rijksinstituut voor Kust en Zee |
| R&D | - | Research and Development |
| R&S | - | Reports and Studies |
| SADC | - | Southern African Development Community |
| SARCS | - | Southeast Asia Regional Committee for START |
| SASCOM | - | South Asia Regional Committee for START |
| SCOR | - | Scientific Committee on Oceanic Research |
| SGD | - | Submarine Groundwater Discharge |
| SOLAS | | Surface Ocean Lower Atmosphere Study |
| SOPAC | - | South Pacific Applied Geoscience Commission |
| SPIS | - | Science Plan & Implementation Strategy |
| SC | - | Scientific Committee |
| SSC | - | Scientific Steering Committee |
| START | - | Global Change System for Analysis Research and Training (IGBP Core Project) |
| SURVAS | - | Synthesis and Upscaling of sea-level Rise Vulnerability Assessment Studies |
| SUTRA | - | Saturated-Unsaturated TRAnsport finite-element ground-water simulation model |
| SWOL | - | SARCS/WOTRO/LOICZ |
| UNEP GEF | - | United Nations Environment Programme and Global Environment Facility |
| UNESCO | - | United Nations Educational, Scientific and Cultural Organisation |
| UNFCCC | - | United Nations Framework Convention on Climate Change |
| USGS | - | United States Geological Survey |
| UNH | - | University of New Hampshire |
| URL | - | Uniform Resource Locator |
| USNOPP | - | United States National Oceanographic Partnership Program |
| VROM | - | The Netherlands Ministry of Spatial Planning, Housing and the Environment |
| WCRP | - | World Climate Research Programme |
| WG | - | Working group |
| WOTRO | - | Netherlands Foundation for the Advancement of Tropical Research |
| WFD | - | Water Framework Directive |
| WLF | - | Wildlife and Fisheries |
| WWF | - | World Water Forum |