

LOICZ

**ANNUAL REPORT
1998**



LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE

Contents

	Page
About LOICZ	iii
1. Chair's Report	1
2. Structure and Organisation	2
3. Scientific Activities	4
3.1 LOICZ FOCI	4
3.2 LOICZ WORKSHOPS	8
3.3 LOICZ CORE PROJECTS	15
3.4 LOICZ REGIONAL PROJECTS	16
3.5 LOICZ RELEVANT RESEARCH PROJECTS	17
4. Collaboration	21
5. Communication	23
6. IPO Staff and Operations	25
7. Funding	26
8. Abbreviations list	27

About LOICZ

The world's coastal zones form a long narrow boundary between land and ocean that is highly valued by human societies. The Land-Ocean Interactions in the Coastal Zone (LOICZ) core project of the International Geosphere-Biosphere Program (IGBP) on Global Change studies this relatively small but highly productive, dynamic and sensitive area. The LOICZ International Project Office is hosted by the Netherlands Institute for Sea Research (NIOZ) and funded by the Netherlands government.

Major questions that LOICZ addresses on a global scale are:

- Is the coastal zone a sink or source of CO₂?
- What are the mass balances of carbon, nitrogen and phosphorus in the coastal zone?
- How are humans altering these mass balances, and what are the consequences?
- 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?
- What is the role of the coastal zone in trace gas (e.g., DMS, NO_x) emissions?
- How can knowledge of the processes and impacts of biogeochemical and socio-economic changes be applied to improve integrated management of the coastal environment?

The focus of LOICZ research is on horizontal material fluxes and scaling of processes through environmental and socio-economic sciences. LOICZ depends on national programs of research and individual scientists' contributions, and works with researchers to develop collaborative and multidisciplinary projects to meet the goals. While directed research is initiated to fill gaps in knowledge, LOICZ aims to value-add to the global knowledge base through focussed workshops of experts addressing issues relating to the project questions. The LOICZ Implementation Plan (1995) describes in detail the approaches and purpose of LOICZ.



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1. Chair's Report

The first 5 years of the LOICZ project ended in December 1997, having established a plan of global work, initiated a number of priority research activities, and developed an initial network of global researchers. After an evaluation of the LOICZ performance, the Netherlands government funding agencies (the Ministry of Education, Culture and Sciences and the Ministry of Transport and Public Works) decided to continue the funding for a second 5 years program, 1998-2002.

In the beginning of this second phase, LOICZ has moved from a dominantly planning and network-building function to delivery of integrated science products that address coast zone processes and changes at regional and global scales. The target is to provide a first global synthesis and models of global change in the coastal zone by end of the year 2002, and to cross-link the coastal zone assessment with the family of IGBP core projects (terrestrial, atmospheric, oceanic). This global synthesis is to be provided to the end-users of science, the community and scientific peers.

LOICZ action is in the laboratories and field of the global coastal zone. The LOICZ International Project Office (IPO) provides and supports scientific activities and integration, opportunities and planning, administration and communications.

With the start of the new Executive Officer and Deputy Executive Officer in May and June, respectively, the IPO activities came to full speed again. Apart from the work on existing LOICZ core activities, such as nutrient budgeting, river basin influx and the link between natural and social sciences, a number of new initiatives were started involving regional and thematic projects, and extension of the LOICZ networks.

Priority has been placed on workshops and research that develop regional biogeochemical budgets, coastal typology methodologies, interaction of people and river process and discharges.

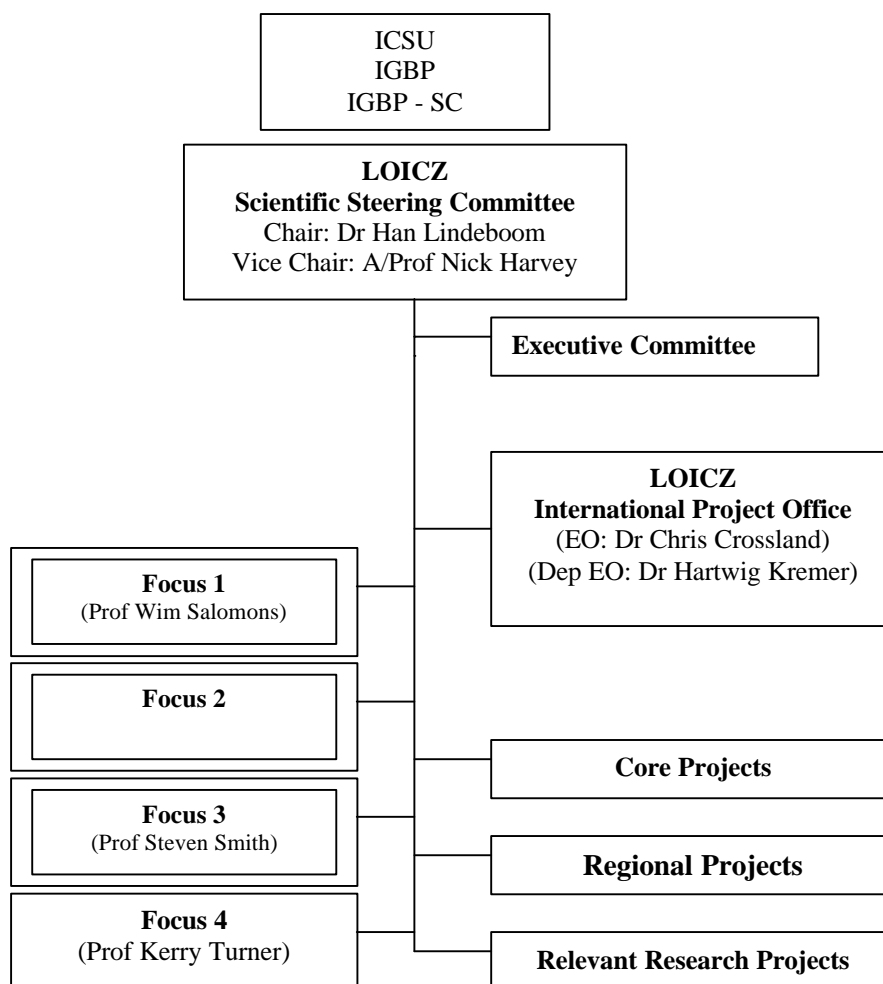
Additional contributing projects have been gained from most regions of the world, with strong input from Europe (especially ELOISE and the UK LOIS). The Netherlands LOICZ Committee is finalising agreements for a major program of research. New projects are being developed for 1999 that focus on the South America, South Asia, Caribbean and Oceania regions.

Internal and external communications are vital to the program that now includes a contact network of more than 2300 people and agencies throughout the world. The application of the science produced by LOICZ is an important issue. A strong liaison has been built with the Netherlands Coastal Zone Management Centre (RIKZ) and a clear link has been made with IOC as a crucial mechanism for delivering our science to the global intergovernmental forum.

Han Lindeboom
Chair
LOICZ Scientific Steering Committee

2. Structure and Organisation

The Land-Ocean Interaction in the Coastal Zone (LOICZ) project was established by IGBP in December 1992 with the adoption of the LOICZ Science Plan (IGBP Report No.25), and became the sixth core project of IGBP (itself a program of ICSU).



LOICZ Organisation Schema

The **Scientific Steering Committee (SSC)** provides scientific guidance and oversees the development, planning and implementation of the LOICZ core project. The SSC was established by the IGBP Science Committee (IGBP-SC) which is responsible for the appointment of the Chair, Vice-Chair and members.

SSC Membership

Dr Han Lindeboom (Chair)	Netherlands Institute for Sea Research, The Netherlands
A-Prof Nick Harvey (Vice-Chair)	University of Adelaide, Australia
Dr Larry Awosika	Nigerian Institute for Oceanography, Nigeria
Dr Robert Buddemeier	University of Kansas, USA
Prof. Edgardo Gomez	University of the Philippines, The Philippines
Prof. Patrick Holligan	Southampton Oceanography Centre, UK

Prof. Hu Dunxin	Chinese Academy of Science, P.R. of China
Dr Silvia Ibarra Obando	CICESE, Mexico
Dr Gerardo Perillo	Instituto Argentino de Oceanography, Argentina
Prof. Wim Salomons	GKSS Research Centre, Germany
Prof. Steven Smith	University of Hawaii, USA
Prof. Kerry Turner	University of East Anglia, UK
Prof. Frederik Wulff	Stockholm University, Sweden
Prof. Jahara Yahaya	University of Malaya, Malaysia
Prof. Tetsuo Yanagi	Kyushu University, Japan

The SSC met once in 1998 at Adelaide, Australia.

The **Executive Committee** (EXCOMM) is a subcommittee of the SSC which, at the direction of the SSC, deals inter-meeting with special issues and reports to the SSC with recommendations. The EXCOMM comprises the SSC Chair, Vice-Chair and the four Foci Leaders.

The EXCOMM met once in 1998 at Texel, The Netherlands.

The **Foci** are the four key program activities of LOICZ (see Section 3) coordinated by the Foci Leaders. **Core Projects** directly address the Science Plan goals and are coordinated by the SSC. **Regional Projects** are closely linked to the Science Plan (but may have additional aims) and are coordinated at regional level. **Relevant Research Projects** make a scientific contribution to LOICZ, often at local or thematic levels.

Activities of the research elements of LOICZ are outlined in Section 3.

The **LOICZ International Project Office** (IPO) is responsible for the administration of the project on a day-to-day basis, under the long term guidance of the SSC. Its role includes coordination, planning, communication, advocacy and provision of a technical secretariat. It is located at the NIOZ, Texel, The Netherlands.

The Executive Officer, Dr Chris Crossland, and the Deputy Executive Officer, Dr Hartwig Kremer, were new appointments in mid-1998. A Liaison Officer, Maarten Scheffers, is located at the RIKZ Coastal Zone Management Centre, The Hague.

3. Scientific Activities

The scientific activities of LOICZ are directed at two major thrusts. First, the development of horizontal material flux models from continental basins through regional seas to continental margins, based on our understanding of biogeochemical processes and data for coastal ecosystems and habitats and the human dimension. Second, the scaling of the material flux models at spatial scales from local to global, and across temporal scales.

LOICZ activities are organised through focal groups (Foci), particularly for integrative and developmental action on Thematic issues and workshops involving global researcher expertise. Core projects of on-going work address global scale issues and cross-Foci objectives. Regional project research involves large spatial scale questions, often cross-boundary and multidisciplinary. Relevant research projects contribute information crucial to LOICZ objectives but at local or short temporal scales; this information is brought together through thematic or regional workshops initiated through the Foci.

In 1998, major priority and effort by the Foci has been placed into further determining biogeochemical budgets (Focus 3), developing methods for coastal typologies and scaling to global spatial dimensions (Focus 2), and integrating catchment basin process understanding and the human dimension (Foci 1 and 4).

3.1 LOICZ FOCI

Focus one

Effects of changes in external forcing or boundary conditions on coastal fluxes

Focus Leader: Prof. Wim Salomons

Work in Focus 1, aims to describe and model the status and changes of horizontal fluxes of nutrients, carbon and sediments into the coastal sea through river catchments, the atmosphere, and exchange processes along the continental margins. Emphasis is given to the dynamics and delivery of materials from the global catchment basins. The core project activities of the joint LOICZ/JGOFS Continental Margins Task Team (CMTT) provides the main route towards understanding shelf margin transfers.

In 1998, activities concentrated on flux changes driven by human activities in the catchment basins, and the environmental state changes and impacts they cause in the coastal sea as the major receiving body. In close co-operation with Focus 4, emphasis was put on applying the DPSIR (Drivers, Pressures, State, Impact, Response) framework to the descriptive part of the scientific work. Here, close coupling between natural and socio-economic science disciplines was employed in order to evaluate relationships between environmental impacts and responses by policy makers and managers. Drivers and state changes were identified from existing data.

A major activity in the second half of the year was a series of workshops run jointly by Focus 1 and 4 which directly followed the recommendation of the annual ELOISE conference in Huelva, Spain during late September. The objectives were to review European catchment research and its potential for science integration, and to fill the

Continental Aquatic Systems (CAS)-related gaps in knowledge by new European proposals to be submitted for the first call of the EU FP5 (see Workshops, below). An inventory of key projects and the links to the CAS initiative will be published in the first half of 1999 as a LOICZ R&S report.

Input from Focus 1, in cooperation with Focus 4, supported an initiative by the State of Bremen, Germany, which is aimed at the establishment of a research and training project in the Caribbean region. LOICZ, together with the GKSS Research Center, Geesthacht, and the Carl Duisberg Gesellschaft (CDG), Bremen, assisted with a mission to the regional demonstration sites and to the planning and preparation of the first workshop with local partners, to be held in January 1999 in Bremen. Furthermore, in November LOICZ IPO participated in a presentation of the GKSS to the European Commission, in support of EU funding for the project. Following its SSC meeting in April 1998 in Adelaide, LOICZ confirmed its willingness to endorse and support the project by linkage to a Caribbean core project as part of the overall LOICZ Latin America work.

The collaborative action between Focus 1 & 4 was extended through Prof. Salomon's active participation in the Dutch LOICZ Focus 4 commission. The resulting project implementation plan is currently waiting for the first call for proposals to be launched by the Dutch governmental bodies.

Foci 1 and 4 have cooperated in LOICZ-related publication efforts, including:

- a book on Coastal Zone Management that the respective foci leaders have been editing and which is due to appear in mid-1999; and
- a new peer-reviewed journal (Prof. Wim Salomons as a chief editor) on *Regional Environmental Change* (published by Springer; web link <http://link.springer-ny.com/link/service/journals/10113/index.htm>.)

Focus two

Coastal biomorphology and global change

Focus Leader: Dr Robert W. Buddemeier

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

Focus 2 activities during the past year have been characterised by a high level of interaction, both with entities external to LOICZ and among other LOICZ Foci and projects.

In January a symposium and final workshop was held by the jointly sponsored SCOR-LOICZ Working Group 104 (Coral Reef Responses to Global Change: The Role of

Adaptation). This led to the identification of the potential importance to corals and other calcifying organisms of the changes in surface ocean saturation state that are being forced by rising levels of atmospheric CO₂. The proceedings of the symposium is now published as volume 39 (1) of *American Zoologist* (1999), and a report on the relationship between CO₂, saturation state, and calcification has been accepted by the journal, *Science*.

This year also saw the initiation of SCOR-LOICZ Working Group 112 (Magnitude of Submarine Groundwater Discharge and its Influence on Oceanographic Processes), with an initial meeting held at the Western Geophysics meeting in Taiwan. Although closely related to LOICZ Focus 1, this activity is being coordinated through Focus 2 because of the strong tie-ins with typology and geomorphology as well as with biogeochemical fluxes to the coastal zone.

Some major steps were taken in the further development of coastal typologies and refinement of the LOICZ typology database. A workshop was held in Hawaii in October, and a number of promising avenues were identified and explored. In particular, a clustering approach developed by Dr Bruce Maxwell appears to have strong potential for exploration of coastal classifications and their potential relationship to biogeochemical budgets. This work is being pursued.

The issue of sea level change is being addressed by A-Prof. Nick Harvey (LOICZ SSC), who is coordinating the interaction and further development of regional initiatives in the Pacific region, to characterise both past and anticipated future sea level rise, and the effects on coastal structure and function.

Focus 2 has also been cooperating closely with Focus 3 in the development of regional case-study initiatives (e.g., Mexico, Australia), and an integrated case study covering the issues of all Foci was carried out in Mexico in February 1998, with the results submitted for publication.

Focus three

Carbon flux and trace gas emissions

Focus Leader: Prof. Stephen V. Smith

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 phase 1 of the project (LOICZ R&S Report No. 5, 1996). The key goal is determining the relative autotrophy or heterotrophy of the coastal systems 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 flux estimations of trace gases in addition to CO₂ (such as N₂O and CH₄) in the coastal zone.

The primary activity of Focus 3 continues to be the development of coastal zone biogeochemical budgets. This work has primarily been undertaken at the University of Hawaii, under the direction of Prof. S.V. Smith. Progress was relatively slow during the first portion of the year (with the addition of approximately 4 new

budgets). This situation changed as a result of a workshop hosted by CSIRO Land & Water in Canberra, Australia during October 1998. More than 30 budgets have come from that workshop, as well as important revisions and modifications for the modelling guidelines. The further 'hidden' point is that several budgets not currently on the Budgets Modelling webpage are presently under development. In addition, a bibliography of relevant references for sites which might be budgeted has been put on the Budgets Modelling webpage (<http://data.ecology.su.se/MNODE>).

The recent hiring of an assistant to work at the University of Hawaii (Ms Vilma Dupra, University of the Philippines) should also speed up budget development over the next year. Ms Dupra is assisting with 'local budget development', working with collaborators elsewhere, and assisting with workshops.

A second major activity of Focus 3 has been the continued development of the Budgets Modelling webpages. This has been largely undertaken at the University of Stockholm, under the direction of Professor F. Wulff; he has been ably assisted by Dr Dennis Swaney.

A workshop was held in San Quintin, Mexico during February 1998, to use that location as an 'example site' for physical-socioeconomic integration. A paper from the workshop has been submitted to the journal, *Regional Environmental Change*.

Finally, Focus 3 efforts on biogeochemical budgeting will be dovetailed into Focus 2 work on developing global coastal zone typologies. It is anticipated that the extensive budget sites for both Mexico and Australia will make these ideal regions for local 'tuning' of the typology - budget interactions.

Focus four

Economic and social impacts of global change in coastal systems

Focus Leader: Prof. Kerry Turner

The Focus addresses the two elements of human dimensions in the coastal zone, looking at the co-evolution of coastal systems under different scenarios of global change (essentially the impacts of humans) and the effects of changes to coastal systems on social and economic activities.

The first element aims 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. Key issues include: congestion and carrying capacity in coastal areas, capacities of small island (especially in relation to tourism development), and the relationship between people and specific coastal ecosystem changes in the use of coastal resources (for example, mangroves and coral reef systems).

The second element seeks to develop tools for producing regional and global forecasts of the effects of coastal changes on the human dimension, particularly through coupling natural science and economic models. This work involves the building of an understanding and database on economic valuation and cost-benefit approaches,

within a context of community and wider stakeholder evaluations, in order to assess vulnerability of coastal systems and human populations to global change.

In 1998, work continued on integrated modelling of natural and economic sciences using the Driver-Pressure-State-Impacts-Response (DPSIR) concept as a framework. A compendium of the modelling approach and case examples was published as a *LOICZ R&S Report* No. 11; this provides a guideline for use and application of the methodologies in different regions of the world.

In addition to the continuing Southeast Asian SWOL project, linked with Focus 3, major effort went into the development of links with the Focus 1 research addressing river basins processes. Here, the human dimension exemplified through the DPSIR concept provided a principal framework and context for evaluation and synthesis both of tactical research and existing information (mainly in the European region), and for the development of strategic research proposals. This joint work is outlined in the workshop reports, below.

3.2 LOICZ WORKSHOPS

1. SCOR/LOICZ Working Group 104 Symposium: Coral reefs and environmental change – adaptation, acclimation or extinction? (January 1998)

The symposium developed by the SCOR Working Group 104, jointly sponsored by LOICZ, addressed the issues of coral reef responses to global change, and especially the role of adaptation. The symposium received support and sponsorship from the Society for Integrative and Comparative Biology (SICB), the International Society for Reef Studies (ISRS), and the Ecological Society of America (ESA). It was presented at a joint meeting of those societies January 3-7 1998 in Boston, USA, with additional support from the Coastal Ocean Program of the US National Oceanic and Atmospheric Administration (NOAA).

The major conclusion was that increasing atmospheric carbon dioxide inhibits calcification by many marine calcifying organisms and by coral reef ecosystems. This is the first major indication of large-scale negative biological effects as a direct result of CO₂ itself rather than as an outcome of its possible effects on climate.

This striking conclusion arose from observations that calcification rates of corals, coralline algae, and coral-algal communities depend on the calcium carbonate saturation state of surface seawater, which is reduced by rising atmospheric carbon dioxide. This global, systemic, climate-related stress on the functioning of reef ecosystems interacts with the more immediate anthropogenic local threats to an important and already threatened coastal ecosystem. The findings also emphasise the importance of coastal processes in the complex relationships among marine, atmospheric, and terrestrial contributions to the interacting organic and inorganic components of the carbon cycle -- key IGBP concerns.

Other important outcomes of the meetings offered additional insights into coral reef systems - all of interest to both researchers and managers, and not all of them negative in their implications. Corals, and to some extent reef communities, were shown to possess numerous mechanisms for acclimatization and adaptation - diverse reproductive strategies, flexible symbiotic relationships, physiological acclimatisation,

habitat tolerance, and a range of community interactions. However, current understanding of these mechanisms, as well as of the critically important calcification mechanisms, is still inadequate for reliable predictions or for effective contribution to the design of sustainable management practices.

It was also made clear that coral reef stresses and responses involve communities and populations that are products of processes operating over a wide range of interacting time and space scales, with fundamentally different controls operating at different scales. While short term responses will be controlled by local environmental conditions and biotic responses, the longer-term sustainability of a reef system depends on the recruitment, dispersal, persistence, and interactions of populations at scales larger than those of most current management and assessment practices.

A peer-reviewed proceedings of the symposium will be published as an issue of the journal *American Zoologist* 39(1) 1999 and the key science findings will contribute to an article in the journal, *Science* in April 1999. Additional information can be found in (*Science* vol. 279, p. 989 (1998), and at http://coral.aoml.noaa.gov/themes/coral_cg.html).

2. LOICZ/San Quintin Workshop: Ecological services and socio-economic sustainability: a case study (February 1998)

A workshop was held from February 1 to 7, in San Quintin, Mexico aimed at using the San Quintin ecosystem (land and ocean) as a conceptual model to develop principles of linking natural and social components in the land-ocean flux of materials.

The selected site, the San Quintin system (30°N, on the Baja California peninsula, Mexico), represents a system of a valley and bay where natural influences are clearly defined and anthropogenic influences are strong. Weak coupling between the land and bay allowed study of the two sub-systems independently. Participants included two systems ecologists, a hydrogeochemist, a geologist, a marine chemist, two, and a socio-economist with background in oceanography.

Workshop participants visited the agricultural area located in the coastal plain of the Valley where agriculture occupies about 15,000 hectares, with tomatoes and strawberries being the main crops. This activity provides employment for about 15,000 people, but is not sustainable. The valley and adjacent watershed are desert, with the agriculture supported by extraction of groundwater to such an extent that the water table is declining and saltwater intrusion is occurring. Agricultural production is almost entirely for export. With this activity, the local population is about 60,000; without it, they would probably number no more than a few thousand.

Along the bay, the main economic activity is oyster aquaculture, over about 400 of the 50,000 hectares of the bay. Seasonal coastal upwelling along the Pacific coast of Baja California results in a high productivity of the ocean. Biogeochemical budgeting of the bay demonstrated an import of organic detritus associated with the upwelling, which provides an important food supply to organisms in the bay, including the cultured organisms. No other food or raw materials are required to support the aquaculture. Aquaculture employs 350 people, and only 30% of the production is

exported. This activity is sustainable at its present level, because the oysters are maintained by exchange of water and organic matter with the highly productive coastal water.

The workshop assessed economic and community factors (often by interviews), and evaluated biogeochemical budgets and models for nutrients, groundwater and the coastal system. A model was developed that can be applied to similar studies in other coastal areas, to link land and ocean and natural and social sciences, and ultimately to lead to predictions and management decisions at global and local scales. Results of the study have been submitted for publication in the journal *Regional Environmental Change*.

3. SCOR/LOICZ Working Group 112 Workshop: Global assessment of submarine groundwater discharge (July 1998)

The Scientific Committee on Oceanic Research (SCOR), with LOICZ joint sponsorship, established a working group of experts to examine groundwater discharge in the coastal zone. Direct groundwater flow into the ocean occurs as springs and seeps in near-shore areas in many parts of the world. Some of these springs are large enough to have been exploited for human needs, but perhaps much more important is the slow yet persistent seepage of groundwater that flows out along most shorelines of the world. Although less spectacular than large springs, seepage may occur over broad areas and deliver a potentially significant amount of flow and dissolved components to the world's oceans.

Although submarine groundwater discharge has been recognised for many years, the process has not received much scientific attention because of either (i) a perception that it is unimportant; and/or (ii) the difficulty in measurement. Studies performed over the past few years have presented convincing arguments that direct groundwater flow to the ocean can be important, at least in some areas. Measurement difficulties haven't been overcome but progress is being made.

It thus appeared opportune to establish an international working group to address questions relating to assessment of the magnitude and influence of groundwater discharge in the coastal zone. SCOR/LOICZ Working group 112 was approved at the General Meeting of SCOR in Rio de Janeiro in October, 1997. Bill Burnett (USA) and Evgeny Kontar (Russia) are the co-chairs and Robert Buddemeier (USA) is the LOICZ liaison for the team. The group met in conjunction with the Western Pacific Geophysical Meeting in Taipei (July 20-24, 1998) and organisational arrangements, work plans and research options were developed. A meeting of the full working group is scheduled during the International Association of Hydrological Sciences (IAHS) Meeting in Birmingham, UK (July 19-30, 1999).

4. LOICZ/CSIRO Workshop: Australasian coastal estuarine systems: carbon, nitrogen and phosphorus fluxes (October 1998)

More than 30 new estuarine biogeochemical budgets were developed for Australia, New Zealand and New Guinea at a workshop in Canberra, Australia on 12-14 October 1998. Hosted by CSIRO Land & Water and led by Steve Smith, the 20 scientists presented stoichiometric C-N-P budgets across tropical and subtropical systems with

locations ranging in scales from 10's to 100's of km². The resulting budgets add to the handful of existing assessments for the region and are being posted to the LOICZ Web site. A comprehensive report (*LOICZ Reports & Studies* No. 12) will be published in April 1999 and also made available on CD-ROM.

The workshop demonstrated an extensive amount of data and continuing research on nutrients, science and management regimes to ameliorate impacts on catchments, waters from urban and agricultural developments, and groundwater aquifers. It is likely that further evaluations of existing time-course data could demonstrate direct system responses resulting from options taken in the management of human activities in estuarine catchments and the biogeochemical processes and systems performance.

Latitudinal comparisons of estuarine net productivity, nitrification and nutrient loads were made from the array of sites investigated. These are reported in the workshop publication, and are expected to link closely with companion developments LOICZ is making in its global typology approaches.

The workshop provided a vital opportunity for detailed discussions on the LOICZ "budgets" approach. While there was accord on the approach, issues such as effects of water residency times, and the implications of spatial and temporal variation on methodologies were considered in some depth. Outcomes from these discussions added further to the successful progress of LOICZ Focus 3 initiatives and manuscripts are being prepared for publication in scientific literature.

5. LOICZ/University of Hawaii Workshop: Development of coastal typologies (October 1998)

The development of a coastal typology system that describes the global coastal zones is an imperative for LOICZ. This has been a taxing issue for the program as a whole - not just the collection and development of "useful" databases but, importantly, the development of an appropriate methodology. While vital to LOICZ, this is a "red-hot" issue in current global research.

Some exciting and cutting-edge developments were made in a LOICZ workshop (16-18 October 1998) hosted by the University of Hawaii and led by Bob Buddemeier. Eight researchers brought together their research advances, previously developed through e-mail collaboration. Questions of scaling, databases, coastal system analyses, methods and approaches to aggregation of sites and pixels, and the selection of test sites were debated and tested.

The questions of scaling and aggregation of data are vexing issues, in which fractal analyses may contribute some partial answers. The modification of databases to discriminate between coastal (coastline), coastal seas and terrestrial blocks of information is not a trivial process - the LOICZ Typology Database offered a starting point for examination of direct and derivative information and indicators of processes and numeric parameters. Ways to define similarity or dissimilarity between the 9600 1-degree pixels which outline the global coastal zone is a challenge - simple regression and correlation approaches are not useful to segregate or aggregate the hierarchy of information.

The group is continuing its work, gaining a wider collaboration with other interested researchers, and building on the workshop outcomes. The apparent quantum jump being made in these developments is expected to be more widely demonstrated by scientific publications in the near future.

6. START/LOICZ Oceania Workshops: Coastal zone management, and climate change (October 1998)

The START-Oceania Committee held its inaugural meeting at the University of South Pacific (USP) in Fiji from 5-9 October, 1998. The START-Oceania Secretariat is based at USP and administrative staff will be appointed in 1999.

The inaugural START-Oceania meeting was held in conjunction with two workshops, Coastal Zone Management and Climate Change. The meeting was sponsored by the Asia Pacific Network, Japan and the START International Secretariat, Washington, DC. The workshops attracted about 50 scientists from the Oceania region.

The Vice-Chancellor, Mr Esekia Solofa, welcomed the international participants and challenged START-Oceania to develop expertise and training relevant to the region rather than provide scientific advice based on westernised perspectives linked to foreign aid programmes. Two plenary sessions set the global, regional and local contexts for each of the two workshop themes; one addressing climate change and the other dealing with coastal zone management issues in the region.

The workshops and the inaugural START-Oceania meeting outlined an impressive amount of work and highlighted the co-operation between the regional participants. Four major projects were developed during the workshops, including 'Island-Ocean Interactions in the Pacific' which has strong linkages to the LOICZ Focus 4 theme. These projects are currently being refined and will be submitted in due course to funding agencies for support.

7. IOC/START/LOICZ Workshop: Climate change and coastal processes in West Africa (November 1998)

Current research across West Africa on climate change and coastal processes was addressed at a workshop hosted by the Université Nationale du Benin and sponsored by START-IOC-LOICZ. About 40 scientists from Morocco to South Africa, from francophone and anglophone nations, joined in presentations and discussions of environmental issues, current research on coastal and catchment changes, and management implications from the science.

The diversity of the West Africa coastal zone and the human pressures provided the backdrop for clear outcomes dealing with priorities for sub-regional research on natural and socio-economic processes, data standard and access, communication and dissemination of science findings, and risk and policy considerations.

Water and erosion issues along with the disjunct between science findings and effective policy-making were major messages. The coastal zone of the region is the location of large cities and high population density. Natural oceanographic forcing coupled with anthropogenic activities is causing widespread degradation of the coastal

environment through shoreline erosion, siltation, flooding, salt water intrusion, subsidence and pollution. These hazards are leading to major socio-economic problems. In addressing these issues, the workshop demonstrated clearly that climate change at global and regional scales can have major implications for the region's coastal zone; its processes, biogeomorphology and its socio-economic future.

The workshop was not a one-off event but was a further step in the process of building a framework of communication and research effort on land-ocean interaction within the region. The workshop report and recommendations (IOC publication series) will be published in early 1999.

8. LOICZ/IVM Workshop Series: The river dimensions of coastal region management (November-December 1999)

The first two LOICZ/IVM workshops on river catchment interactions with the coastal region were hosted by the Institute for Environmental Studies (IVM) of the Free University in Amsterdam. The workshops, which were conducted with strong scientific input from IGBP-BAHC, are seen as a starting point in a series organised in contribution to the IGBP Water Group – CAS (Continental Aquatic Systems), an integrative cross-project activity of the IGBP. They also followed-up on the recommendation of the 2nd Annual Meeting of the European ELOISE program held in Huelva, Spain in late September, to create close working accords with LOICZ with special emphasis on the human dimensions of coastal change scenarios.

A major objective was to prepare an inventory of European research dealing with the interactions along the catchment-coast continuum, and to examine the status and potential for generating close interdisciplinary links between natural science, social science and economics. The workshop was scientifically driven by the LOICZ Foci 1 and 4 leaders and reviewed ongoing science within the guidelines of the DPSIR (Drivers, Pressures, State, Impact, Response) framework. These guidelines, (as outlined in *LOICZ R&S Report* No. 11) formed a crucial working background for the meeting.

In addition, two working groups addressed the issues of “Material fluxes in and from the river catchments to the coastal zone” and the “Science-Science Management-Policy Interface”. These aimed at defining the cross disciplinary links (natural and soci-economic sciences) needed for making science useful for the clients and, in this context, to identify opportunities for collaborative projects fitting into the EU 5th Framework program. A number of projects was identified and preliminary outlines were generated

During the second (December, 1998) meeting, the earlier project ideas went through a first level of review and refinement. They will be further developed in January 1999 at the IVM and during a joint ELOISE/LOICZ workshop on “Socio Economic Aspects of fluxes of Chemicals to the Coastal Zone” to be held at the NILU, Kjeller, Norway, 8-10 March 1999.

9. SWOL Annual Meeting & Workshop: Linking regimes of coastal zone flux changes to socio-economic drivers in Southeast Asia (December 1998)

The meeting held in Surat Thani, Thailand, 7-12 December 1998 was hosted by the Thai research team. Objectives of the workshop included:

- ♦ inter-site comparisons of initial economical-environmental Input-Output models;
- ♦ review of links between I/O models and biogeochemical/natural science models;
- ♦ review and further develop steps needed for setting up the return loop from C,N,P fluxes to the economic sector models (dynamic environment – economy interaction);
- ♦ identifying the 1999 directions for SWOL (publications, workshops, knowledge transfer and links to other programs) with an assessment of the crucial issues to be pursued in a potential second phase project;
- ♦ highlighting experiences acquired throughout this project regarding databases and tools needed for natural and socio-economic science integration, and success or failure of model application – in order to provide advisory competence for global change projects like LOICZ and SARCS.

Detailed results are presented in the annual reports, available as single documents for each site:

- Integrated Biogeophysical & Socioeconomic Modelling of the Sungai Merbok Mangrove Estuary. Mangrove Ecosystem Research Group, Centre for Marine and Coastal Studies, University Sains, Malaysia, 1998
- Economic Evaluation and biophysical modelling of the Lingayen Gulf in support of management for sustainable use, Manila, Philippines. SWOL Annual Report, 1998
- Economic Evaluation and Biogeochemical Modeling of the Impact of Shrimp Farming on the mangrove Systems of Ban Don Bay, Surat Thani Province, Southern Thailand, SWOL Annual Report, 1998
- Hoang Tri *et al.* 1998: Constructing an Economic – Environmental Input – Output Model: Case Study in the Red River Region, Vietnam. SWOL Annual Report, 1998

The national research groups and resource persons recorded excellent progress in the development of the I/O modelling approach and its linkages with the natural sciences modelling. It was shown that since the 1997 Bolinao workshop, each of the research groups has carried out complementary studies on the implementation of the I/O modelling to

- a) quantify the economic states in each site and
- b) attempt to link the residuals generated by socio-economic drivers to information from biogeochemical budget modelling.

Estimates of the major horizontal nutrient fluxes (C, N, P), including seasonal features, are in place. Links made with the estimates for residual production allow the relative contribution of different socio-economic drivers to current horizontal fluxes to be outlined. This feeds directly into the requirements of dynamic modelling, which is now being addressed.

In terms of the synthesis needed during the final project year 1999, it appears that an overall structure for the integration of biogeochemical budgets and the human dimension in terms of socio-economic data will be achieved. This final step is

expected to be ready for presentation and discussion at the concluding SWOL meeting scheduled for the forthcoming LOICZ Open Science Meeting in Bahia Blanca, Argentina, Nov, 08-19 1999. A publication of the results as a LOICZ R&S report is expected.

3.3 LOICZ CORE PROJECTS

The LOICZ core projects address global issues, either by production and testing of widely applicable models of change in the coastal zones or by providing wide geographic syntheses of information on coastal properties, coastal flux rates or coastal processes and their rates of change.

Six core projects are established in LOICZ (see webpage www.nioz.nl/loicz/), with the European Union ELOISE project being contributed in 1998.

Title	Related Foci
Biogeochemical Budgeting Modelling	3
Coastal Typology Development	2
Continental Margins Task Team (CMTT)	1&3
Deltaic Processes	2
ELOISE	1 to 4
SARCS/WOTRO/LOICZ Southeast Asia Research	1,3&4

ELOISE

The European Land-Ocean Interactions Study (ELOISE) was accepted as a core project of LOICZ following discussions between representatives of LOICZ and the EU Directorate XII, and with scientific participants.

On invitation of the Commission, LOICZ representatives attended the ELOISE 2nd Annual Scientific Conference in Huelva, Spain (September 30 - October 3, 1998). The conference gave a comprehensive overview and status of about 30 European Land-Ocean Interaction Studies comprising some 300 researchers. It is the biggest European project cluster supported through the MAST and Environment and Climate Programme of the EU dealing with:

- Global Changes and Biogeochemical Cycles and Fluxes in European coastal seas and catchments;
- Ecosystem Structure and Functioning and Human Impacts and
- Coastal Zone management and integration of natural and socio-economic science

A new ELOISE working group on Socio-Economic Aspects of Fluxes was set up which, jointly with LOICZ, developed an outline paper addressing science integration, science communication and brokering which is to be published in the forthcoming second ELOISE Implementation Report.

SWOL

During the last three years, the SARCS/WOTRO/LOICZ (SWOL) project on coastal zone research in Southeast Asia has made visible progress in trying to integrate natural and social science towards comprehensive assessments of change regimes in

coastal zones. Emphasis has been placed on modeling the status and changes of carbon fluxes and trace gas emissions in the regional demonstration sites, and how to couple the findings with economic and social drivers of the change in coastal systems. Thus SWOL covers all LOICZ foci. The annual meeting of the principle investigators held in Surat Thani, Thailand, 7-12 December 1998, reviewed status of the studies and, recognising that the project enters its final year in 1999, discussed new priorities and major working directions.

Before the annual meeting, a preparatory workshop was held in Penang, Malaysia, July 1998, concluding with consideration of needs and goals for both the project's final year and a potential second project period. Major challenges for improved input/output model application were identified to be in the integration of sociological settings into the overall biogeochemical/socio-economic modelling work. Furthermore, involvement of a time component allowing for enhanced dynamic and predictive model-capacity was addressed. In this context database and scaling questions were considered to be crucial issues.

Other Core Project activities are reported under Workshops and elsewhere in this report.

3.4 LOICZ REGIONAL PROJECTS

Regional projects contribute to LOICZ global issues within a regional framework.

Regional project activities have been extended by the addition of the UK Land-Ocean Interactions Study (LOIS). A major integrated study in Morocco is being reviewed prior to acceptance (Integrated Coastal Zone Study and Management, Chief Investigator: Prof Maria Snoussi). Current projects are listed below and further information is available from the LOICZ webpage (www.nioz.nl/loicz/).

Title	Investigator	Location
Great Barrier Reef	Terry Done	Australia
Land-ocean interactions in southern South America	J-l Probst	European Union
AFFORD	W. Ebenhoeh	Germany
Ecology of tropical coastal systems: mangrove dynamics and management: MADAM	Ulrich Saint-Paul	Germany
Sustainable use of coastal ecosystems : EUROBASIN	Wim Salomons	Germany
Lower Volta mangrove project : Phase 1 Assessment of environmental, economic and social factors	Christopher Gordon	Ghana
Integrated coastal zone mangement in Banten Bay	A Nontji	Indonesia
Carbon and nutrient fluxes and socio-economic studies of the Merbok mangrove ecosystem	Ong Jin-Eong	Malaysia

BOA research theme on tidal areas	Herman Riderinkhof	Netherlands
Economic and technological aspects of internationally coordinated strategies	H Verbruggen	Netherlands
EROS 2000 Black Sea	Peter Herman	Netherlands
Sustainable management of the coastal area of SW Sulawesi	Pieter G E F Augustinus	Netherlands & Indonesia
Sustainable use of international river basins: definitions, criteria & assessment	W P Cofino	Netherlands
Economic evaluation and biophysical modelling of the marine environment of Bolinao: supporting sustainable use	Liana Talaue-McManus	Philippines
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)	V Gordeev	Russia
Economic evaluation and biophysical modelling of impacts of shrimp farming on mangrove systems in Ban Don Bay	Gullaya Wattayakorn	Thailand
Land-ocean interaction study (LOIS)	Graham Leeks	United Kingdom
Economic evaluation studies of mangrove conservation and rehabilitation in Nam Ha Province	Nguyen Hoang Tri	Vietnam

3.5 LOICZ RELEVANT RESEARCH PROJECTS

The relevant research projects are contributed by chief investigators and institutions, and usually involve local scale studies. The database of projects is currently being reviewed and updated, and the following listing is representative rather than comprehensive.

<i>Chief Investigator</i>	<i>Project Title</i>	<i>Country</i>
Prof. Dr. F.I.Isla	Coastal dynamics and comparative evolution of the Eastern and Southern barriers of Buenos Aires.	Argentina
Prof. Dr.F.I.Isla	Coastal evolution of the eastern barrier of Buenos Aires.	Argentina
Prof. Dr. F.I.Isla	Morphological characterization of the coast of Tierra Del Fuego, between San Sebastian and San Diego Capes.	Argentina
Dr. M. Frankignoulle	Biogas transfer in estuaries (BIOGEST) (ENV4-CT96-0213).	Belgium
Dr. M. Frankignoulle	Carbon fluxes in coral reefs.	Belgium
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	Fluxes and biogeochemical process of carbon and heavy metals in the Tseng-Wen estuarine and coastal environment.	China ROC

Dr. J.T. Liu	The sediment dynamics of the Tseng-Wen River coastal dispersal zone-numerical model and GIS application.	China ROC
Dr. K. T. Shao & Dr. S. R. Kuo	The role of fish communities in the coastal dispersal of Tseng-Wen River (II) – feeding ecology.	China ROC
Dr. Yung-Chi Chen	Trace element biogeochemistry in mangrove swamp.	China ROC
Dr. T. Dalsgaard	Nitrogen cycling in estuaries (NICE) (MAS3-CT96-004).	Denmark
Prof. B.v. Bodungen	Transport and turnover in the Pomeranian Bight (TRUMP).	Germany
Mr. S. Dick	TRANSWATT subproject: transport processes.	Germany
Prof. Dr. L.A.Meyer-Reil	Interdisciplinary research project, OKOBOD.	Germany
Mr. A. Mueller	SWAP-modelling of some abiotic and biotic aspects in the Sylt-Rømø Bight.	Germany
Prof. Dr. Rullkoetter	PAKOMIN Subproject: sedimentation, conservation and diagenesis of organic matter under the influence of high sediment accumulation.	Germany
Prof. Dr. J. Sündermann	KUSTOS: Coastal mass and energy fluxes – the land sea transition in the Southeastern North Sea.	Germany
Dr. A.L. Paropkari	Eastern Arabian sea marginal exchange processes (EASMEX).	India
Dr. N. Ramanujam	Monitoring and modelling of groundwater behaviour and cliff recession in relation to wave climate in the coastal belt.	India
Dr. K. N. Rao	Remote sensing studies on coastal biogeomorphological environments in the Godavari Delta region.	India
Dr. T. Miyagi	Mangrove habitat dynamics and sea-level change.	Japan
Dr. M.K.W. Osore	Assessment of marine pollution in a former mangrove creek.	Kenya
Dr. Gi Hoon Hong	Inner continental shelf in the southern sea of Korea: processes and products (INCOSPR).	Korea
Dr. E. Shumilin	Trace elements in coastal sediments of Baja California Peninsula, Mexico.	Mexico
Dr. R. Akkerman	Marine Monitoring System 2000+ for the North Sea Region (MAS3-CT96-0057).	Netherlands
Dr. R.P.M. Bak	Dynamics and diversity of coral reefs.	Netherlands
Dr. R.P.M. Bak	Gradients in coastal reefs and adjacent systems.	Netherlands
Dr. R.P.M. Bak	Small food web/benthos studies.	Netherlands
Dr. Ir. A.G. Brinkman	Modelling the impact of climate change on the Wadden Sea Ecosystem.	Netherlands
Prof. D. Eisma	Fluxes of ²¹⁰ Pb and associated radioisotopes in coastal seas (North Sea, Adriatic).	Netherlands
Prof. D. Eisma	Transport and deposition processes of inorganic and organic suspended material in the North Sea.	Netherlands
Prof. D. Eisma	Transport and deposition processes of suspended matter in several West-European estuaries.	Netherlands
Dr. H.G. Fransz	Effects of nutrient supply on plankton primary and secondary production and species composition.	Netherlands
Dr. H.G. Fransz	Particulate matter North Sea: semi-empirical algorithm development.	Netherlands

Dr. W.W.C. Gieskes & Dr. J. Stefels	Entangled sulphur and carbon cycles in <i>Phaeocystis</i> dominated ecosystems (ESCAPE) (MAS3-CT96-0050).	Netherlands
Prof. C.H.R. Heip	Impacts of nematodes on physical properties of sediments.	Netherlands
Dr. P. Hoekstra	Morphodynamics of wave-dominated coastal environment in Telu Banten; managing deltaic shorelines and reef systems.	Netherlands
Dr. P. Hoekstra	Three dimensional flow patterns and sediment fluxes in Teluk Banten.	Netherlands
Dr. J. Middelburg	Carbonate dissolution in vegetated and bioturbated estuarine and coastal sediments.	Netherlands
Dr. J. Middelburg	Methane and nitrous oxide emission, production and consumption rates.	Netherlands
Dr. W.A. Oost	PROMARIS	Netherlands
Dr. J. van der Plicht	Origin and characterisation of suspended and sedimental organic matter by means of carbon isotopes.	Netherlands
Prof. Dr. G. D. Vogels	Carbon cycling in the coastal zone of Tanzania.	Netherlands
Dr. J. Voogt	Morphological and ecological effects of sea level rise on the Wadden Sea.	Netherlands
Prof. W.J. Wolff	Ecological research to support the development of management strategies for West African estuaries.	Netherlands
Dr. E.I.C. Agwu	Developing methodologies for integrated socio-economic and natural sciences research of changes in the Imo River Estuary.	Nigeria
Prof. J. S. Gray	Key coastal processes in the mesotrophic Skagerak and oligotrophic N. Aegetan (KEYCOP).	Norway
Prof. Yngvar Olsen	Comparative analysis of food webs based on flow networks: effects of nutrient supply of structure and function of coastal plankton communities (COMWEB) (MAS3-CT96-0052)	Norway
Prof. G. Fang	Studies on impacts of climate and land environmental changes to the hydrographic structures in the Bohai Sea.	P.R. of China
Prof. H. Hong	The biogeochemical processes of C, N and P in Taiwan Strait related to the pelagic fishery resources.	P.R. China
Dr. F. Li	Impact of human activities on ecological environment in the Yellow River estuary and its adjacent sea.	P.R. of China
Dr. Xie Qinchun	Behavior of fine sediment in Jiaojiang Estuary.	P.R. of China
Dr. W.W.S. Yim	International Geological Correlation Program Project no.396: 'Continental shelves in the Quaternary	P.R. of China
Dr. W.W.S. Yim & Prof. P.Li	Holocene record of typhoons in coastal sediments of Southern China	P.R. of China
Dr. W. Campos & Dr. R. Baleña	An oceanographic survey of Philippines Archipelagic waters: 1. Central Philippines.	Philippines
Prof. Dr. C. Borrego	AMAZOC – Atmospheric environment in coastal zones: assessment of ecosystem load capacity.	Portugal
Dr. V.N. Korotaev	Investigation of estuarine-deltaic systems morpholithodynamics.	Russia
Mr. A.N. Voronov	Pollution transport to the Baltic Sea via groundwater runoff.	Russia

Mr. I. Wright	The Quaternary evolution of the northern KwaZulu-Natal coastal plain using the Kosi Lake/Estuary.	South Africa
Dr. A. Polonsky	Hydrometeorological and hydrographic field variability over the Black Sea coastal zone.	Ukraine
Dr. M. J. Bray	Environmental changes and management of coastal systems.	United Kingdom
Dr. T. Jickells	Air-sea exchanges of trace elements particularly nitrogen and trace metals.	United Kingdom
Dr. T. Jickells	Nutrient and metal cycling in estuaries and coastal environment.	United Kingdom
Dr. I. G. Littlewood	River mass load estimation techniques (LOIS)	United Kingdom
Prof. R. F.C. Mantoura	Marine organics.	United Kingdom
Dr. D.C. Mason	Inter-tidal digital elevation models using satellite data.	United Kingdom
Prof. J. Orford	The morphosedimentary response of gravel-based coastal barriers to sea-level rise.	United Kingdom
Prof. J. Orford	The impact of climate change and relative sea-level rise on the environmental resources of European coasts.	United Kingdom
Prof. J. Orford	Variation in coastal forcing and its coastal response along the European Atlantic shoreline.	United Kingdom
Dr. J.M.C. Plane	Land-Ocean Interaction Study (LOIS)-RACS (Atmosphere).	United Kingdom
Dr. C. Reynolds	Long-term assessment of physical and biological components in the waters of the Windermere catchment.	United Kingdom
Prof. I. Shennan	Land-Ocean Interaction Study (LOIS)-Land-ocean evolution perspective study (LOEPS).	United Kingdom
Prof. J.H. Simpson	Land-Ocean Interaction Study (LOIS) – Shelf edge study (SES).	United Kingdom
Prof. D.E. Walling	Sediment sources, sediment delivery and longer-term sediment responses of RACS river basins.	United Kingdom
Dr. 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
Dr. Tran Duc Thanh	Sediment budget and influence of moving and closing the inlets on the Tam Giang Lagoon ecosystem.	Vietnam

4. Collaboration

LOICZ depends on an extended global network of scientists to achieve its goals. A major element of the project is the support provided through national governments and their research agencies and universities. In many countries, there is a national LOICZ Committee established, usually associated with a national IGBP Committee. Through this aegis, projects are developed which address LOICZ objectives and researchers contribute their science to the wider spatial picture being developed by regional and global actions of the LOICZ project. An example is the Dutch LOICZ Committee which has developed an implementation plan addressing global change and which will involve an array of national research capabilities in a number of integrated projects. This initiative will enhance the already close commitment to LOICZ by national agencies, such as, RIKZ Coastal Zone Management Centre and the Netherlands Institute for Sea Research (NIOZ).

In some countries, LOICZ is supported by institutions and networks of specialist scientists. For example, CSIRO Land & Water in Australia recently hosted a major workshop which delivered more than 30 biogeochemical budgets for the Australasian region, contributing to the global assessment of nutrients and knowledge of the relative autotrophy of the world's coastal zones.

Major regional programs also are part of LOICZ, including projects with varying degrees of integration which provide regional assessments of the LOICZ key questions. Here, the European Union ELOISE and the UK LOIS programs are recent contributions to the LOICZ project. Elsewhere, collaborative action within South East Asia, West Africa, Latin America, and the Arctic regions are being followed with the aim of enhancing or establishing regional programs.

Within IGBP, LOICZ continues to build links and collaborative activities with the terrestrial and ocean projects, notably JGOFS, GLOBEC, BAHC, LUCC and DIS. In 1998, joint workshops and working groups have been operating and further work will deal with IGBP cross-cutting projects, such as, assessments of change in global carbon and water. A close association with the SCOR global program has been sustained, with the completion of the jointly-sponsored Coral Reef working group (SCOR WG 104) and the start of a jointly-sponsored Working Group (112) addressing Submarine Groundwater Discharge.

A major goal for LOICZ is to ensure that the scientific research is utilised by coastal zone managers and policy makers. LOICZ has built a strong 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. With IOC, a focus in 1998 has been towards joint actions and consultation on integrative coastal assessment and management (ICAM), developments in Coastal-GOOS, and capacity building in world regions, including Africa and Oceania.

LOICZ has continued to liaise closely with the IGBP START project on capacity building and training in regions, jointly organising several workshops during 1998. These initiatives, and the developing contacts with other agencies pursuing capacity

building projects (for example, the Inter Americas Institute and the Asia Pacific Network), will continue to be an important strand of LOICZ work.

While these institutional arrangements are vital to the success of LOICZ, it is the individual scientists, coastal managers and policy-makers which ensure the operational products and the achievement of LOICZ goals. More than 2300 people and key agencies are involved in the LOICZ network and are increasingly involved in the activities and science delivery which underpins LOICZ enterprise.

5. Communication

Communication within and beyond LOICZ is fundamental to the effectiveness and success of the project. The network nature of LOICZ and its continuing evolution of science imposes a challenge that is increasingly being met through electronic media. However, we recognise that people are the key resource and that while electronic media provides for broad contacts, not all scientists and science-users have the same level of access to cyberspace. Consequently, LOICZ attempts to target its products by a mix of printed and electronic publications. Also, the synergies that develop in workshop environments are clearly an advantage and benefit from the efforts made to bring experts together, with electronic partnerships preceding and following up on face-to-face meetings and training programs.

In 1998, LOICZ has continued to use a mix of communication tools to disseminate its findings and to promote the network of players, internally and with users.

Newsletter

Four quarterly copies of the LOICZ Newsletter (Nos. 3-9) were produced and each was distributed to more than 2300 people and agencies. The Newsletter contained at least one scientific article, along with news and updates on the LOICZ project activities, and provided notice of the calendar of relevant meetings and workshops within and associated with the project. We plan to enhance the science content during 1999, reflecting in part the increased products and activities of LOICZ.

Brochures and Poster

In 1998, a brochure was produced describing LOICZ and providing an entry point for those interested in participating and developing contact. This was successfully released at the Lisbon "Year of the Ocean" Expo and has been distributed at conferences and workshops in different parts of the world. Published in four languages (English, French, Portuguese, Spanish), the brochures are used separately and in support of LOICZ posters.

IGBP has provided a set of posters and an overhead transparency series which have been used in support of LOICZ presentational material at a number of workshops and meetings.

LOICZ Website

The LOICZ website (www.nioz.nl/loicz/) is of increasing importance as a means of communication and as an archive. The website was upgraded in 1998 and a continuing process of addition and modification is being followed. Copies of all recently printed materials are available through the site, contributing project lists are kept current along with contacts for chief investigators, links are provided to other coastal science sites, and new publications are listed which deal with coastal research and coastal zone management.

The LOICZ website provides direct and indirect access to LOICZ databases, especially for biogeochemical budgets and typology. Much of this work is being developed through dedicated websites which provide access to day-to-day progress. Discussion pages on methods and findings from LOICZ enterprise also are being established to meet the demands of a global network of participants in LOICZ work.

Publications

Numerous publications have been produced from research projects contributing to LOICZ – Core, Regional and Relevant Research projects. LOICZ IPO is currently developing an index and listing of this work for inclusion on the website in 1999.

LOICZ publishes a variety of meeting and workshop reports, listed on the LOICZ website. A number of these deal with planning and development issues and are generally of interest within elements of the LOICZ project. In addition, LOICZ has been placing increased effort to publication of its science. This will continue as a major activity. Examples of science and key workshop publications include:

LOICZ 1998. Report of LOICZ Open Science Meeting 1998: *Global Change Science in the Coastal Zone*. LOICZ Meeting Report No. 29, LOICZ International Project Office, NIOZ, The Netherlands, pp. 244.

Turner R.K., W.N. Adger and I. Lorensoni 1998. *Towards Integrated Modelling and Analysis in Coastal Zones: Principles and Practice*. LOICZ Reports & Studies No. 11, LOICZ International Project Office, NIOZ, The Netherlands, pp.122.

American Zoologist **39** (1) 1999. Papers from the symposium on Coral Reefs and Environmental Change – Adaptation, Acclimation, or Extinction, organised by Robert W. Buddemeier and Howard R. Lasker

LOICZ (in press). *Australasian Estuarine Systems: Carbon, Nitrogen and Phosphorus Fluxes*. Eds. S.V. Smith and C.J. Crossland. LOICZ Reports & Studies No. 12, LOICZ International Project Office, NIOZ, The Netherlands.

6. IPO Staff and Operations

Judith van Bleijswijk continued as project assistant in the first four months of the year, in which period Han Lindeboom, Chair of the Scientific Steering Committee acted as part-time Executive Officer. In May 1998, Chris Crossland from Australia joined the IPO as Executive Officer, followed by Hartwig Kremer from Germany who became Deputy Executive Officer at the end of June.

In August, LOICZ data analyst Martijn van der Zijp left the office after three years of developing the LOICZ Typology Database, and establishing the new website. Also in August, Maarten Scheffers from the National Institute for Coastal and Marine Management (RIKZ) was appointed as liaison officer between LOICZ and the Coastal Zone Management Centre in The Hague. Cynthia Pattiruhu and Mildred Jourdan continue to provide vital office management and support.

The IPO has been working closely with the LOICZ SSC, particularly the EXCOMM, to re-shape and prioritise the work needed to achieve the goals of a first global synthesis by end 2002. A draft Strategy and Work plans is nearing completion and will act as a guide for the remaining four years of the LOICZ second phase.

Associated with this development has been an extensive effort to ensure that LOICZ captures a wider network and collaboration of coastal researchers, and develops mechanisms for information transfer to users of coastal science information. We have seen a strengthening of links and greater inclusion of European researchers and institutions. Elsewhere, collaboration has been enhanced with IGBP core projects, such as LUCC, BAHC and GLOBEC, and increased regional engagement has proceeded or is planned with, for example, South Asia and Latin America. While LOICZ will deliver its outcomes through the IGBP, effort has been placed into establishing close links with coastal zone management agencies and forums. The close working relationship the Netherlands Coastal Zone Management Centre is a vital link, and working relationships with the Intergovernmental Oceanographic Commission (IOC) and European Union (EU) are steps forward.

The IPO has provided strong support to Foci and workshops development – activities whose focus is on yielding tactical science outcomes rather than strategic plans. The intensity of work will increase with projected new funding from UNEP GEF to support LOICZ enterprise, and will continue to provide a challenge to complete project-based publications and supportive administration and financial management by LOICZ. The strong and continued support by our hosting agency, NIOZ, is a key element in the success of IPO operations.

7. Funding

The Netherlands government generously agreed to continue support of the LOICZ International Project Office and core activities for the second phase of the project, 1998-2002. This vital funding is received from the NWO and RIKZ, and supplemented with support from IGBP for meetings of the LOICZ Scientific Steering Committee.

In addition to major core funding support for the IPO from The Netherlands government, LOICZ has gained significant project funding from The Netherlands WOTRO and is finalising arrangements for a project with UNEP supported by GEF funds. Other project proposals are with the European Union, The World Bank, the Inter American Institute and IGBP-START.

In-kind support, especially from NIOZ and RIKZ, and many national government agencies continues to underpin LOICZ activities. In particular, the support from CSIRO in Australia and the Vrij University in The Netherlands have contributed to workshop activities. The LOICZ SSC and the member activities are supported by a range of universities and national agencies.

Income and areas of expenditure by LOICZ in 1998 are shown below. A detailed and fully audited financial statement is prepared annually by the LOICZ IPO host institution, NIOZ.

1998	Dutch
Income (cash)	Guilders
Dutch government (NWO, V&W RIKZ)	840 000
IGBP	50 000
Special projects	195 400
Total	1 085 400
Expenditure (cash)	
IPO operations and support	500 940
Workshops and Activities	280 465
Communications & publication	45 700
Provisions (e.g., Open Science Meeting 1999)	190 000
Forward commitments (Workshops & project activities)	68 295
Total	1 085 400
In kind contributions (direct)	
NIOZ	160 000
V&W RIKZ	100 000
Other	186 000
Total	446 000

8. Abbreviations list

BAHC	-	Biospheric Aspects of the Hydrological Cycle
CICESE	-	Centro de Investigación Científica y de Educación Superior de Ensenada
CSIRO	-	Commonwealth Scientific and Industrial Research Organisation
DIS	-	Data and Information System
ELOISE	-	European Land-Ocean Interaction Studies
EU	-	European Union
EU FP5	-	European Union Fifth Framework Programme
GLOBEC	-	Global Ocean Ecosystem Dynamics
GOOS	-	Global Ocean Observing System
ICSU	-	International Council for Science
IOC	-	Intergovernmental Oceanographic Commission
JGOFS	-	Joint Global Ocean Flux Study
LOIS	-	Land-Ocean Interaction Study
LUCC	-	Land-Use Cover Change
MAST	-	Marine Science and Technology
NILU	-	Norwegian Institute for Air Research
NIOZ	-	Netherlands Institute for Sea Research
SARCS	-	South Asia Regional Committee for START
SCOR	-	Scientific Committee on Oceanic Research
START	-	Global Change System for Analysis Research and Training
SWOL	-	SARCS/WOTRO/LOICZ
UNEP GEF	-	United Nations Environment Programme Global Environment Facility
WOTRO	-	Netherlands Foundation for the Advancement of Tropical Research