

LOICZ NEWSLETTER

Integrated Ecological Economic Modelling of the Patuxent River Watershed, Maryland

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There has been a major movement over the last decades toward place-based, ecosystem-based, and watershed-based management. To support this effort to effectively manage the complex interactions between human and natural systems at the watershed scale, integrated (across scales and across disciplines) scientific and technical knowledge and models are needed. We have developed an integrated modeling framework aimed at addressing these goals. The approach evolved from work in coastal Louisiana and in the Everglades. Current work is focused on the Patuxent river watershed in Maryland, one of the best studied tributaries of the Chesapeake Bay, and one that has often been used as a model of the entire Bay system, and on the Gwyns Falls watershed in urban Baltimore, as part of the Baltimore Long Term Ecological Research (LTER) project.

In particular the modeling framework is aimed at addressing the following general questions.

1. What are the quantitative, spatially explicit and dynamic **linkages** between land use and water and nutrient fluxes and terrestrial and aquatic ecosystem productivity and health.
2. What are the quantitative **effects** of various combinations of natural and anthropogenic stressors on ecosystems and how do these effects change

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

- with scale.
3. What are useful ways to measure changes in the total **value** of the landscape including both marketed and non-marketed (natural system) components and how effective are alternative mitigation approaches, management strategies, and policy options toward increasing this value.

The Patuxent Landscape Model (PLM) was designed to serve as a tool in a systematic analysis of the interactions among physical and biological dynamics of the watershed, conditioned on socioeconomic behavior in the region. A companion socioeconomic model of the region's land use dynamics was developed to link with the PLM and provide a means of capturing the feedbacks between ecological and economic systems. Because of the complex feedbacks and nonlinear dynamics of this watershed, a "systems" approach was neces-

sary. A key part of this process was the development of an integrated, dynamic, spatially explicit simulation model.

In the ecological component of the model, the important processes that affect plant communities are simulated within the varying habitats distributed over the landscape. The principal dynamics modeled are: 1) plant growth in response to available sunlight, temperature, nutrients, and water; 2) flow of water plus dissolved nutrients in three dimensions as mediated by ; 3) decomposition of dead organic material and formation of soil organics. Using this approach to incorporating process-based data at a reasonably high spatial, temporal and complexity resolution within the entire watershed, the changing spatial patterns and processes can be analyzed within the context of altered management strategies, such as the use of agricultural Best Management Practices (BMPs) (e.g. reduced tillage).

The Model

The modeled landscape is partitioned into a spatial grid of nearly 2,500 square unit cells. The model is hierarchical in structure, incorporating an ecosystem-level "unit" model that is replicated in each of the unit cells representing the landscape. The General Ecosystem Model (GEM) which was developed for the Everglades Landscape Model (ELM), was modified for use within the framework of the PLM. The model was reformulated on a modular basis, with modules representing functional components of the system and capable of being run and calibrated independently.

The same unit model structure runs in each cell. Individual modules are parameterized according to habitat type and georeferenced information for a particular cell. The habitat-

dependent information is stored in a parameter database which includes initial conditions, rate parameters, stoichiometric ratios, etc. The habitat type and other location-dependent characteristics are referenced through links to geographic information system (GIS) files. Thus, when run within the spatial framework of the PLM, the landscape response to hydrology and water quality is effectively simulated as material flows between adjacent cells. The independent modules and the full unit model have also been run in the spatial implementation and rigorously tested at the full watershed scale. Sensitivity analysis was used to gain insight about the model dynamics, showing the varying response of plant production to different nutrient requirements, with subsequent changes in the soil water nutrient concentrations and total water head. Changes in the plant canopy structure resulted in differences in transpiration, and consequently water levels and plant production.

The spatial model combines the dynamics of the unit model which are calculated at each time step for each cell in the landscape, and adds the spatial fluxes which control the movement of water and materials between cells. Each cell generates stock and flow values which provide input to or accept output from the spatial flux equations.

After the water head in each raster cell is modified by the vertical fluxes controlled in the GEM unit model, the surface water and its dissolved or suspended components move between cells based on one of the two algorithms used. In the first algorithm a certain portion of water is taken out of a cell and added to a cell downstream defined by the link map. This may not be the adjacent cell, but a cell several links down the path of the flow. The length of the flow path is defined by the amount of water fluxed and is calibrated so that the water flow rates match gage data. The other algorithm checks that water movement stops when the water heads in two adjacent cells equilibrate. While the first algorithm works well for the piedmont area with significant elevation gradients, the second one is

more appropriate for the coastal plain region where there are significant areas of low relief and tidal forces which permit counterflows. The ecological model is linked to a companion economic model that predicts the probability of land use change within the seven counties of the Patuxent watershed (Bockstael 1996). The economic model allows human decisions to be modeled as a function of both economic and ecological spatial variables. Based on empirically estimated parameters, spatially heterogeneous probabilities of land conversion are predicted as functions of predicted land values in residential and alternative uses, and costs of conversion. Land value predictions, themselves, are modeled as functions of local and regional characteristics. The predictive model of land use conversion generates the relative likelihood of conversion of cells, and thus the spatial pattern of greatest development pressure. To predict the absolute amount of new residential development, the probabilistic land use conversion model must be combined with models of regional growth pressure. Linking the ecological and economic models allows the effects of both direct land use change through human actions and indirect effects through ecological change to be evaluated, as well as the feedbacks between the two.

A variety of spatially and temporally disaggregated data is required to develop and calibrate the PLM model. The database we have assembled includes time series, spatial coverages (maps) and parameters. The model data base contains the data which drive the model forcing functions, parameterize equations and provide calibration and verification data for adjusting model parameters and comparing model output to the real system. The data base was developed from extensive data sets collected for the Patuxent watershed by various governmental agencies, academic institutions and research programs. Existing data for the local region were supplemented with broader regional data bases.

To adequately test model behavior and to reduce computational time, we performed the calibration and

testing at several time and space scales, and for the unit model independently of the full spatial model. We developed a Model Performance Index (MPI) to study the model's response to parameter changes. The MPI framework allows one to develop an error function which can handle the full range of variables and data quality that usually confront complex models. It employs a multi-criteria approach, which allows user weighing of the model variables to reflect their degree of importance and also weighting the data to reflect its quality. It can deal with both quantitative and semi-quantitative information about the expected behavior of the state variables (like the pattern of temporal autocorrelation, boundaries, steady state).

Calibrating and running a spatial model of this level of complexity and resolution requires a multi stage approach. We first identified two spatial scales at which to run the model - a 200 m and 1 km cell resolution. We then identified a hierarchy of subwatersheds. The whole watershed has been divided into a set of nested subwatersheds to perform analysis at three scales. The inclusion of plant and nutrient dynamics improved the model's hydrologic performance in comparison to the output reported above. The spatially explicit representation of plant and nutrient dynamics modifies the evapotranspiration and interception fluxes in the model, making the model performance more realistic. It was also essential for scenario runs that take into account land use and cover changes, in which these changes modify the hydrologic fluxes in the watershed.

Scenarios

The goal of the linked ecological economic model development was to test alternative scenarios of land use management. A wide range of future and historical scenarios may be explored using the calibrated model. We have developed scenarios based on the concerns of county, state and federal government agencies, local stakeholders and researchers. The following set of initial scenarios was considered:

A group of **historical scenarios** based on the USGS reconstruction

of land use in the Patuxent watershed:

(1) 1650 – pre-development era. Most of the area forested, zero emissions.

(2) 1850 – agro-development. Almost all the area under agricultural use, traditional fertilizers (marl, river mud, manure, etc.), low emissions.

(3) 1950 – decline of agriculture, start of reforestation and fast urbanization.

(4) 1972 – maximal reforestation, intensive agriculture, high emissions.

(5) **Baseline scenario.** We use 1990 as a baseline to compare the modeling results. The 1990-1991 climatic patterns and nutrient loadings were used.

(6) **1997 land use pattern.** This data set has just recently been released and we used it with the 1990-1991 forcings to estimate the effect of landuse change alone.

(7) **Buildout scenario.** With the existing zoning regulations, we assumed that all the possible development in the area occurred. This may be considered as the worst case scenario in terms of urbanization and it's associated loadings.

(8) **Best Management Practices (BMP)** – 1997 land use with lowered fertilizer application and crop rotation. These management practices were also assumed in the remaining scenarios.

A group of scenarios of change in land use over the 5 years following 1997 (i.e. for 2003) developed based on the **Economic Land Use Conversion (ELUC)** Model by N. Bockstael:

(9) Development as usual

(10) Development with all projected sewer systems in place

(11) Development with no new sewers but contiguous patches of forest 500 acres and more protected

(12) Development with all sewers in place and contiguous forest protected

Another group of hypothetical scenarios to study more **dramatic change in land use** patterns using the 1997 land use as the starting point:

(13) Conversion of all agricultural land into residential

(14) Conversion of all agricultural land into forested

(15) Conversion of all residential

land into forested

(16) Conversion of all forested land into residential

(17) Residential clustering – conversion of all low density residential land use into urban around 3 major centers

(18) Residential sprawl – conversion of all high density urban into residential randomly spread across the watershed.

The scenarios were driven by changes in the Landuse map, the Sewers map, patterns of fertilizer application, amounts of atmospheric deposition, and location and number of dwelling units. We compare the model output in the different scenarios looking at nitrogen concentration in the Patuxent River as an indicator of water quality, changes in the hydrologic flow and changes in the net primary productivity of the landscape.

Comparing the effect of various land use change scenarios on the water quality in the river shows that there is no obvious connection between the nutrient loading to the watershed and the nutrient concentration in the river. However some conclusions can be drawn. The effects of loadings which are distributed more evenly over the year are much less pronounced than those which occur sporadically. For example, fertilizer applications that occur once or twice a year increase the average nutrient content and especially the maximum nutrient concentration quite significantly, whereas the effect of, say, atmospheric deposition is much more obscure. The difference in atmospheric loading between Scenarios (1) and (3) is almost 2 orders of magnitude, yet the nutrient response is only 5-6 times higher, even though loadings from other sources also increase. Similarly the effect of septic loadings that are occurring continuously is not so large.

The average N concentration is well correlated (corr=0.77) with the total amount of nutrients loaded. The effect of fertilizers is also high (corr=0.74), while the effect of other sources is much less (septic corr=-0.0075; decomposition corr=-0.2267; atmosphere corr=0.49). The fertilizer application defines the maximum nutrient concentrations

(corr=0.71), with the total load also playing an important role (corr=0.60), whereas the contributions of individual sources is less pronounced (septic corr=0.0878; decomposition corr=-0.271; atmosphere corr=0.28). Even the groundwater concentrations of nutrients are closely related to the fertilizer applications (corr=0.89), however in this case the septic loadings play a larger role (corr=0.59), even a more important one than the total N loading (corr=0.44).

The hydrologic response is quite strongly driven by the land use patterns. The peak flow (max 10% of flow) is almost entirely determined by urbanization (corr=0.94). The baseflow (min 50% of flow) is somewhat related with the number of forested cells (corr=0.54), but obviously many other factors also influence it.

Different land use patterns result in quite significant variations in the net primary productivity (NPP) of the watershed, both in the temporal and in the spatial domains. The pre-development 1700 conditions produce the largest NPP, while under Build Out conditions NPP is the lowest. In the latter case the dynamics of NPP is more representative of the agricultural landuse with higher NPP values attained later in the year as crops mature. Interestingly under the BMP scenario with lower fertilizer applications we still get a higher NPP than under reference conditions of 1997, because of the crop rotation and growth of winter wheat that matures earlier in the season than corn.

The major result of the analysis performed thus far is that the model behaves well and produces plausible output under significant variations in forcing functions and land use patterns. It can therefore be instrumental for analysis and comparisons of very diverse environmental conditions that can be formulated as scenarios of change and further studied and refined as additional data and information are obtained. The real power of the model comes from its ability to link hydrology, nutrients, plant dynamics and economic behavior via land use change. The model allows fairly site specific effects to be examined as

well as regional impacts so that both local water quality and Chesapeake Bay inputs can be considered. The linked ecological economic model is a potentially important tool for addressing issues of land use change. The model integrates our current understanding of certain ecological and economic processes to give best available estimates of effects of land use or land management change. The model also highlights areas where knowledge is lacking and where further research could be targeted for the most impact.

The continental shelf pump: a pilot study in the North Sea

Helmuth Thomas

The role of coastal seas in the global carbon budget and the continental shelf pump hypothesis will be verified by a pilot study in the North Sea starting early 2001. The LOICZ-relevant project - funded by the Netherlands Organisation for Scientific Research (NWO) - will be carried as international co-operation under the direction of the Netherlands Institute for Sea Research (NIOZ), Texel.

Emphasis will be on establishing a synoptic field data set comprising the relevant carbon and nutrient parameters with high spatial and seasonal resolution. Carbon, nitrogen and phosphorus pools and fluxes will be assessed simultaneously. Special attention will be given to the interactions between the carbon, nitrogen and phosphorus pools on the one side and hydrography on the other side. Considering the atmosphere, the North Atlantic Ocean, and the Baltic Sea as sources and sinks internal conversions and transport processes of notably carbon and nutrients into and out of the North Sea will be assessed by data evaluation and eco-system modelling.

Several longstanding open questions can thus be addressed: Whether and to what extent do coastal seas, in this case the North Sea, act as sink or source for atmospheric CO₂? How efficient is the "biological CO₂ pump" in the North

Sea and does it export CO₂ into the Atlantic Ocean thereby acting as "continental shelf pump"?

Estuarine Systems of East Asia

A group of 14 researchers met in Hong Kong, 13-15 June 2000, to develop C-N-P nutrient budgets and models for estuarine systems in the East Asia region. The LOICZ UNEP workshop, one of the LOICZ regional series supported by the Global Environment Facility through UNEP, was generously hosted by Prof. Ming Wong and staff from the Hong Kong Baptist University. Participants from Russia, China, Korea, Japan and Taiwan took part in plenary and tutorial discussions which addressed various modelling and budgetary tools developed to assist the application of the LOICZ biogeochemical assessment approach to describing the global coastal zone.

The hands-on elements of the workshop applied the tools and ten site budgets were fully developed. Issues of scaling, submarine ground water discharge and regional forcing (including human factors) were considered. Two additional tutorial "tools" were developed in the workshop, including a way to estimate the estuarine mixing volume across the open boundary in the absence of a salt gradient and an approach for additional understanding of horizontal mixing in 2-layer box model systems. The region appears to be relatively data-rich and existing research programs are making further contribution to understanding nutrient transformations, changing loads and fluxes, and applying the scientific understanding to coastal environmental management issues. Additional sites have been identified to which further work will be applied for LOICZ purposes to increase the number of local descriptions of coastal lagoon and estuarine ecosystems and regional sea nutrient processes.

The workshop outcomes will be contained in a LOICZ R & S Report currently under preparation, and the developed and further budgets will be contributed to the LOICZ biogeo-

chemical modelling database contained on the dedicated website (<http://data.ecology.su.se/MNODE/>) which is also accessible through the LOICZ website.

African and Indian Ocean Estuaries

Sub-saharan Africa and the Indian Ocean estuarine systems were the subject of two workshops during September 2000. The workshops involved more than 35 scientist in both training in estuarine modelling and in developing more than 20 nutrient budgets for estuarine systems across the extensive region.

Sixteen scientists from sub-Saharan Africa were hosted by the Institute of Marine Science, University of Dar es Salaam on Zanzibar, 12-14 September, as part of the regional program of workshops supported by LOICZ/UNEP-GEF. The new computer version of CABARET for budget calculations, supported by a tutorial booklet, provided a base for the training sessions. Nutrient budgets for 13 estuarine systems from Tanzania, Kenya, Camerons, Guinea and South Africa were developed during the workshop. A number of other systems were identified as having necessary data available and the workshop participants are continuing to extend the site description work more widely in their countries and within the region.

The developed budgets and the regional extension of the network of researchers is a vital element for LOICZ; this and continuing scientific assessments will be key contributions to the integration activities in the Africa-Europe thematic workshop planned for mid-2001. Prof Howard Waldron, University of Cape Town has taken on the role as Regional Mentor, to continue as a focus point for "budgeteers" from the region. Dr Amani Ngusara will take up a LOICZ UNEP scholarship in Manila and Hawaii, to build further on the budgeting and modelling capacities. The new budgets will be posted to the LOICZ Biogeochemical Budgets and Modelling web site, and a workshop report is in preparation as part of the LOICZ R&S series.

While the Zanzibar workshop was hard work and a great success, it was not without its trauma; the hotel venue was badly damaged by fire immediately following the workshop and several of our participants, while unhurt, suffered some loss of personal property. The hotel is to be rebuilt and will undoubtedly continue as a first-class venue for workshops.

With the support of APN, START and LOICZ, the Sri Lanka IGBP Committee hosted a second SASCOM workshop on biogeochemical budgeting and socio-economic modelling for coastal scientists in Colombo, 18-22 September 2000.

This training workshop built on an earlier meeting in 1999, and addressed biogeochemical budgeting and analysis for nutrients and sediments and economic-environmental modelling. More than 20 scientists, from India, Bangladesh, Pakistan, Mauritius, Maldives and Sri Lanka, were augmented by local management agency and NGO representatives during plenary sessions. Both plenary and tutorial sessions were highly interactive and the tools and approaches are being applied to local and regional issues. In addition, 9 estuarine budgets were developed for sites in the region, with more research activities underway to extend these examples. These will provide a crucial contribution to LOICZ understanding in the region and will contribute to the wider thematic workshop addressing Asia which is planned for 2001. A regional research program was developed by participants and has been submitted for funding.

LOICZ AfriBASINS I workshop, 25 – 27 July 2000,

In July LOICZ held its first AfriBASINS workshop in Nairobi, kindly hosted by UNEP Regional Office for Africa and jointly sponsored by KNAS/IGBP, LOICZ, PASS, START, and UNEP/ROA. In this third regional BASINS workshop some 25 scientists representing all major African geographical regions and LOICZ resource persons aimed to provide a state-of-the-art

regional overview on the

- fluxes of nutrients, sediments and other material through the whole catchment/coast cascade,
- how people and economic factors as well as other global change pressures affect those fluxes and
- how the changes observed in the environmental and social states feed back on the anthropogenic system (human dimensions of change).

A comprehensive scientific and institutional network was established, including representatives of GEF (Biodiversity and Land Degradation), the World Bank (African Water Resources Management Forum Interim Task Force) and UNEP/DEIA&EW and the Division of Policy Development and Law. Divided in three sub-regional working teams taking into account the heterogeneous features of North Africa, West Africa and East/Southern Africa the network concentrated on establishing a data and information base considering the existing knowledge and the major gaps in "catchment – coastal sea" interaction issues. The DPSIR (Drivers, Pressure, States, Impacts, Response) scheme proved a practical framework facilitating the review of drivers of change at the catchment level and the identification and first efforts to categorise key pressures on the coastal systems.

The regional assessment will continue to develop a synthesis of horizontal material fluxes and changes of African coastal zone resources and characteristic system functions and how they link to pressures on the catchments. Where possible it will be highlighted how changes in the coastal zone may feed back on the human system. Following a classification of pressure - state scenarios as well as trend analysis on expected change, a set of indices will have to be developed where possible to allow regional and finally global upscaling of the information within the global LOICZ/BAHC typology effort.

As in other regional BASINS meetings the African group identified possible demonstration sites in each region for which to start the development of project proposals. The objective is to address a repre-

sentative range of regional sites through interdisciplinary studies allowing for the development of indicators for sustainable use of coastal zones. Following the critical load concept they are aimed at reflecting the human dimensions of catchment processes and coastal zone response. The projects could employ standardised assessment and modelling tools in both the biogeochemical and socio-economic field as developed under LOICZ and build on and partly follow earlier interdisciplinary efforts such as the modelling of residual productions of material fluxes as in the South East Asian project, SWOL. The proposals can be developed in consultation with other BASINS projects such as EUROCAT.

A major criteria for the site selection is in their potential for upscaling, i.e. to address a set of systems that represent a reasonable coverage of "types" of DPSIR scenarios and related coastal issues allowing comparison on regional and broader scales. While valuable to the LOICZ typology effort, this approach has considerable potential for cooperation with other global IGBP projects such as BAHC, LUCC and PAGES. Besides their contribution to aspects of global change the studies are expected to be relevant for the issues of ICAM processes in Africa.

In conclusion the AfriBASINS network acknowledged the holistic character of the LOICZ BASIN effort. The site studies to be developed out of this context can prove valuable to complement the objectives of various ongoing or planned river-catchment initiatives. Potential for synergies was seen with activities combined under the African Water Resource Management Initiative – West & Central Africa and the Integrated Land and Water Management Action Program for Africa (initiated mainly through the implementing agencies of the GEF). For successful implementation of a continued AfriBASINS in the region, it was however regarded equally important to strive to enable the African "ownership" of this LOICZ approach. UNEP/ROA offered to assist in this process and to provide a platform to distribute and communicate the results and project proposals to the regional gov-

ernments through the African Ministerial Conference for the Environment, AMCEN, in order to seek endorsement for implementation.

The proposals and preparation of the terms of reference for the AfriBASINS II workshop foreseen for mid 2001 was dedicated to an interim regional Steering Committee. The task list adopted comprises identification of gaps in the current scientific understanding of the BASINS processes and in particular to find and involve the socio-economy experts needed for a holistic regional synthesis in AfriBASINS II. Special emphasis will have to be on the development of a scheme of indices for the "pressure – critical load" links on an African scale. The meeting will also have to improve the analysis of major trends of coastal change and related land based processes and resource use and to develop tools for integrated modelling and scenario analyses.

The regional focal points agreed together with PASS, LOICZ and UNEP to facilitate the collection and dissemination of AfriBASINS information to all relevant and interested people and organizations and to investigate the options to cover the various capacity building needs. The network will further identify potential project spin-offs which can add value to other regional programs/initiatives and help attracting potential funding partners (e.g. NORAD, ENRICH; GEF).

IPO notes

While temporary arrivals and departures are commonplace within the IPO, recently there have been more permanent happenings. Mildred is making the most of maternity leave having produced a son (Jordan Llewellyn) and is now undergoing various sociological adaptations. Cynthia is taking up a new challenge with a commercial bank from the end of October. She will be pursuing an expanding career in information technology and training, and will be sorely missed from the IPO.

The LOICZ SSC met in Arcachon, France 2-6 October 2000. Recent initiatives and progress across all areas of LOICZ and strategies for the shift of LOICZ into "synthesis" phase and related planning dominated the meeting. Details on these and other items will be a major topic for the December newsletter.

The SSC held a joint meeting with members of the French PNEC. Common areas of research interest and opportunities for closer collaboration were identified, including the plan for a joint workshop on coastal system modelling in 2001. The PNEC mandate for coastal research and application to management utility is a good fit to the LOICZ purpose and we look forward to further developments.

The Submarine Groundwater Discharge initiatives being taken by the SCOR LOICZ Working Group has received added impetus from the International Oceanographic Commission. The IOC is co-funding a field campaign aimed at intercalibration of methods used to measure SGD; this should provide a firm basis for comparison of existing discharge measures made in different parts of the world albeit with different methodologies. The first study will be held in Perth Western Australia in early December 2000.

Capacity Building and Training

Capacity building and training have grown into an important item on the LOICZ agenda: The Leonardo da Vinci Summer School on ICZM in Bologna early July, the IHDP/START International Human Dimensions Workshop 2000, Bonn, dealing with Changes in the Coastal Zone as well as the most recent ICZM conference called by UNESCO in September in St.Petersburg, Russia, provided a vital platform for multitaragetgroup discussions on deliverables of the LOICZ global change synthesising experiment against coastal management issues.

Taking ICZM's main objective to be managing people and their using of coastal and inland resources standardised tools and scientific methods developed and applied through the global LOICZ community such as the biogeochemical budgeting, the coastal typology needed for comparison and upscaling of environmental states and coastal change scenarios (see LOICZ newsletter No.15) where open for review for their applicability on various management levels. Addressing whole catchment scales as a coastal domain of concern, like in the LOICZ BASINS core project, and setting the stage for stakeholder advisory boards involving multidisciplinary scientific teams as provided by an increasing number of LOICZ projects, were identified to be most suitable for issue driven exploitation of typical LOICZ results. The catchment perspective was seen to further enable better acknowledgement of the institutional dimensions involved when dealing with transboundary issues of changes in coastal zones.

Participants involved in the workshops representing various scientific disciplines covering natural and social sciences as well as young executives and NGOs particularly considered the application of a relatively simple framework such as the DPSIR advantageous when trying to encompass the many aspects of change interactions in the coastal zone. C, N, P and sediment fluxes as key environmental features can

be involved together with land use and cover change driven forcing functions and finally the monetarisation of effects on ecosystem goods and services under changing pressure can be included on various scales.

Experiences made in these capacity building exercises are encouraging and complement those already employed in the LOICZ biogeochemical and integrated modelling efforts (see African and Indian Estuaries – this newsletter). These commitments will therefore remain an important LOICZ activity in future.

Good Response for Special Issue Journals

LOICZ researchers have responded strongly to the invitation to publish in several special issues of journals. Contributed papers are being prepared and edited for two special issues of international peer-reviewed journals including the Journal of Sea Research, and Regional Environmental Change.

Research presentations at the LOICZ 4th Open Science Meeting in late 1999 provided a foundation for the contributed papers. At the close of the submission period, more than 30 manuscripts had been received for consideration in the JSR and REC. Papers will deal with the wide spectrum of LOICZ activities from river catchment processes, estuarine biogeochemistry, continental shelf systems and integration and scaling approaches such as typology developments. Manuscripts are in the process of in-house assessment and editorial processing before being sent for peer review. Journal publication is planned for late 2000 or early 2001.

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These publications, provide one vital window on collective LOICZ re-

search and its contributions to understanding change in the coastal systems of the world. Importantly, the full peer-review processes consolidates the credibility of the core project and adds to the authority of the research findings and interpretations. Other special issue journal opportunities are being sought and it is expected that as LOICZ moves further into its integration and synthesis phase, this avenue for communication will be extended.

HAVE YOU SEEN.....

Socioeconomic aspects of fluxes of chemicals into the marine environment - workshop report, Kjeller, Norway 8-10 March 2000. Eds. Jozef M. Pacyna, Hartwig Kremer, Nicola Pirrone and Klaus Guenther Barthel. European Commission EUR 19089. 2000.

Managing a Sea: the ecological economics of the Baltic. Eds: Ing-Marie Gren, Kerry Turner, Fredrik Wulff. Earthscan Publications Ltd, UK. 2000.

Proc. South Asia Regional Workshop on Estuarine Modelling and Coastal Zone Management. START-LOICZ-IGBP SL 28-30 April 1999 Colombo. Ed: Janaka Ratnasiri. Sri Lanka National Committee of IGBP. 2000.

Bibliography of the Coastal and Marine Environment of the Western Indian Ocean Region. Ed: Edna Nyika, Julius Francis. Institute of Marine Sciences, University of Dar es Salaam. 1999.

Eric Wolanski has edited a new scientific book on physics-biology in coral reefs and adjoining mangroves and seagrass. This book has relevance to tropical coastal, mangrove, seagrass and coral reef management and will be published soon by CRC Press. Further information on: <http://www.crcpress.com/us/prodct.asp?sku=0833+++&dept%5Fid=1>

LOICZ PUBLICATIONS

[Available as printed copies or from the LOICZ web site: www.nioz.nl/loicz/]

Estuarine Systems of the South American Region: C, N, P Fluxes. 2000. LOICZ UNEP workshop report. Eds. V. Dupra, S.V. Smith, J.I. Marshall Crossland and C.J. Crossland. LOICZ R&S no. 15.

LOICZ Web site: *Typology* (<http://water.kgs.ukans.edu:8888/public/Typpages/index.htm>)

LOICZ Web site: *Biogeochemical Budgets and Modelling* - new sites and tutorial materials (<http://data.ecology.su.se/MNODE/>)

LOICZ Web site: BASINS - draft version available under: (<http://www.nioz.nl/loicz/basins/>)

SURVAS Web site: Synthesis & Upscaling of Sea-level Rise Vulnerability Assessment Studies (<http://www.survas.mdx.ac.uk>)

LOICZ CALENDAR

- APN/SURVAS/LOICZ Conference on Coastal Impacts of Climate Change and Adaptation in Asia Pacific Region. 14-16 November 2000. Contact: Prof. Nobuo Mimura (mimura@hcs.ibaraki.ac.jp) or Prof. Tetsuo Yanagi (tyanagi@riam.kyushu-u.ac.jp)
- East Asia BASINS I workshop on catchments/coastal fluxes and human dimensions. 12-14 December 2000. Hong Kong (*by invitation*). Contact: LOICZ IPO
- LOIRA Meeting. 5-8 December 2000. Moscow, Russia. Contact: Dr V.V. Gordeev, (gordeev@geo.sio.rssi.ru)

- LOICZ UNEP Asia and Australasia thematic workshop on upscaling and assessment of nutrient fluxes in coastal estuarine systems. January 2001. Brisbane, Australia (*by invitation*). Contact: LOICZ IPO.
- SAMBAS II workshop on South American Basins and Caribbean catchments/ coastal fluxes and human dimensions. January 2001, Caracas, Venezuela. (*by invitation*) Contact: LOICZ IPO
- LOICZ-UNEP-EU Mediterranean, Black Sea, North Africa workshop on biogeochemical modelling of estuarine systems. February 2001, Athens, Greece. (*by invitation*)
- LOICZ UNEP Americas thematic workshop on upscaling and assessment of nutrient fluxes in coastal estuarine systems. April 2001. Kansas, USA (*by invitation*). Contact: LOICZ IPO
- LOICZ UNEP Africa and Europe thematic workshop on upscaling and assessment of nutrient fluxes in coastal estuarine systems. July 2001. The Netherlands (*by invitation*). Contact: LOICZ IPO.
- LOICZ Scientific Steering Committee Meeting. 7-8 July 2001, Amsterdam. Contact: LOICZ IPO.
- The Third World Fisheries Congress. 31 October-3 November 2000, Beijing, P.R. of China.
- CoastGIS 2001: 4th International Conference on Computer Mapping and GIS for CZM – Managing the Interfaces. 18-20 June 2001, Halifax, Nova Scotia, Canada. More information on <http://agc.bio.ns.ca/coastgis2001>
- IGBP Open Science Conference. 10-14 July, 2001, Amsterdam, The Netherlands. Contact: igbp@congreg.nl, www.sciconf.igbp.kva.se
- 3rd International Conference on Land Degradation and Meeting of the IUSS Subcommittee – Soil and Water Conservation. 24-28 September 2001, Rio de Janeiro, Brazil. More information on www.cnps.embrapa.br/ICLD
- Joint IAPSO-IABO Assembly and XII Colloquium: 2001 - an Ocean Odyssey, Mar del Plata, Argentina, 21-28 October 2001. Contact: gimperill@criba.edu.ar or iado@criba.edu.ar

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OTHER MEETINGS

- GEOTROP 4th International Conference on Environmental Chemistry & Geochemistry in the Tropics. 7-11 May 2001, Townsville, Australia. Contact: Greg Brunskill (g.brunskill@aims.gov.au) or www.tvl.clw.csiro.au/geotrop2001/

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