LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE

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LOICZ NEWSLETTER

Typology: Low-budget Remote Sensing

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Background and Concepts

Suppose that we contracted with a group of very clever engineers to build a satellite from off-the-shelf parts that would return a signal sensitive to the carbon, nitrogen, and phosphorus fluxes in the various parts of the world coastal zone. The satellite is built, launched and it successfully returns lovely images in shades of red, green, blue, and various combinations. A great success -- as soon as we know what the colors mean! To make use of this information, we must have ground truth -- actual on-the-ground and in-the-water measurements of the processes that are represented indirectly by colors from the sky. Once we have measured what is represented by the various colors and combinations, we can construct algorithms to interpolate and extrapolate the images to the times and places where we have not made measurements.

This is a good analogy for the LOICZ approach to determining the global-scale biogeochemical function of the coastal zone. The Biogeochemical Modelling (1) activity is the ground-truth acquisition process, collecting, interpreting, and comparing CNP budgets from coastal sites around the world. The Typology effort (2) is the satellite analogue -- viewing the world from a conceptual distance, on the bases of bands of information represented by globally available environmental databases. To extend the analogy even further, the interpretative algorithms are to be provided in large part by the LoiczView clustering software (3), described below.

This is the fifteenth 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.

If there is such a good model for what we are doing, then why does it generate so much confusion? First, "typology" (study of, or analysis or classification based on, types) is not a common term in the jargon of the scientific disciplines involved. It's a perfectly good English word, but not one that conveys mental images the way 'taxonomy' does, for example. Second, we haven't actually done it all the way yet, so we don't have any complete examples to point to. And, third, we are doing it backwards. We are collecting the ground truth first, wherever we can, and then we will devise through typology an image generator that will produce a generalizable context (the analogue of the remotely sensed image) for the available ground truth.

This process may seem rather imprecise and untidy in a world grown accustomed to evaluating "science" by its reliance on testable hypotheses and an ever-increasing number of high-tech measurements of greater and greater precision. However, a rigorous, linear engineering approach to earth system problems is simply not feasible in many cases. We suffer from a glut of information and a dearth of understanding, and if we are to grasp the holistic nature of large, complex systems we must explore them in breadth as well as in depth. Hence the strategy to use available data (since there is much available and neither time nor money to collect more), and to search for the patterns and connections within.

So Typology will divide the world coastal zone into land, coast and sea cells half a degree on a side,

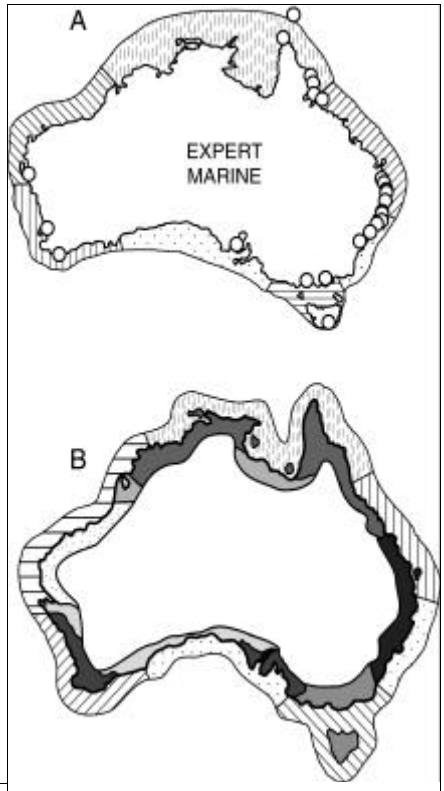

Figure 1: An Australian example - expert typologies developed for the marine (A) and terrestrial (B) coastal environments (reference 9). Circles indicate the location of budget sites.

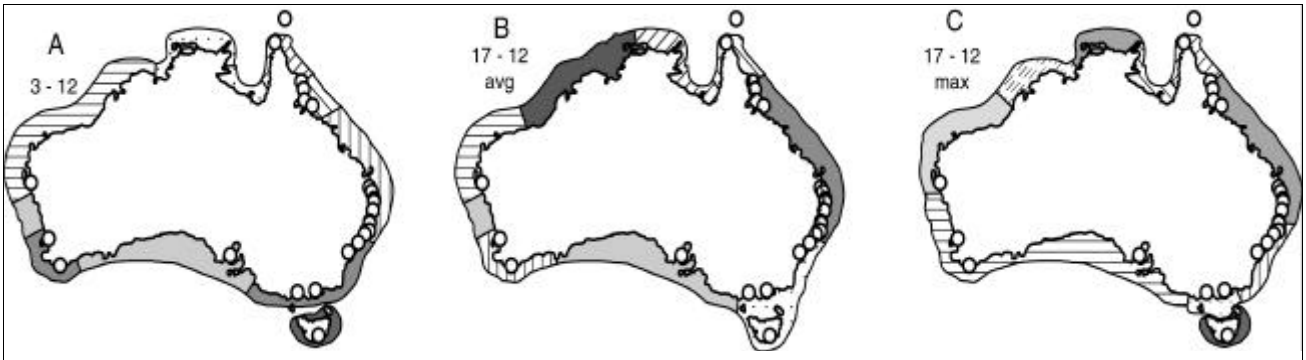

Figure 2: Australia as clustered by the LoiczView approaches described in the text; see text for description of variables. (A) Results using the mean scaled distance and 3 hydrologic variables; (B) Mean scaled distance and 17 variables; (C) Maximum scaled distance and 17 variables. Note: The maps do not show 12 clusters because (1) small and/or highly fragmented clusters were omitted for visual clarity; and (2) New Zealand was included in the clustering experiment, but is not shown here. Symbols are used to distinguish and relate the classes, and do not indicate identity between figures.

and will populate those cells with data on dozens of variables ranging from air temperature to population density and from bathymetry to soil texture. Then various populations of cells will be statistically clustered to identify similarities and differences -- which will in turn be examined for their ability to explain or describe the distribution of types of biogeochemical budgets in the coastal database. Once data selection, weighting and tuning have resulted in a set of typologies that are robustly predictive of the budgets, we will start the process of extrapolating to regional and global coast zone function.

Overall, the process is reminiscent of the classical approaches to scientific exploration. Darwin did not board the Beagle with an engineering design and a set of testable hypotheses for the theory of natural selection -- he arrived at his grand formulation as a parsimonious and convincing model for the way the world works. To do so, he assimilated large amounts of information (his personal observations are an analogue for the global data bases in our case) and brought it to bear on specific phenomena (type budgets are for us what Galapagos finches were for Darwin). We are not necessarily suggesting that the 21st Century analogue of *The Origin of Species* will appear in the LOICZ Reports and Studies series, but we do expect that many new insights will be gained on our way to the global budget estimate.

A tool for the job: LoiczView

We recognize that there are many possible ways, both conceptually and methodologically, to classify and extrapolate coastal characteristics. While we profoundly hope that the coastal research community will develop and test alternative approaches, we also recognized that achieving the LOICZ goals on a credible time scale means selecting and applying some consistent method. Our choice is the LoiczView geospatial clustering software package (3), developed by Bruce Maxwell specifically for this application. The software currently runs on UNIX and LINUX platforms, and is being adapted for deployment on the Internet.

Traditional approaches to typology development are top-down and bottom-up:

In a top-down approach, experts design a decision tree based on different variables and variable ranges that seem appropriate for the environment being considered, apply this scheme to a data set, and iteratively refine the classifications. A variation on this approach is to have experts classify a training set for a pattern classifier and then have the pattern classifier "learn" the classes from the training set and generalize the classification strategy to unseen data.

In the bottom-up approach, a clustering method is used to determine groups of similar data points which then form standard classes. Traditional clustering methods include agglomerative clustering and the K-means clustering algorithm, also known as Vector Quantization [VQ] (4)(5).

The LoiczView package uses the VQ approach, and is specifically designed for application to high-dimensionality data sets (many variables) with imperfect coverage -- missing data and non-normal distributions are an unfortunate fact of life in the environmental sciences. It also includes features that permit selection of number of clusters, number of iterations, distance measure, and visualization options. The last two features are particularly useful for interpretation and tuning of the process. The distance measure issue is discussed below; the visualization option uses a color similarity algorithm that relates the colors of the mapped clusters to the statistical distance between them (e.g., red and pink similar, red and blue very different) (6). A supporting technique, the use of minimum description length and error, has been developed to identifty the optimal number of clusters for a given data set (7)

In the top-down typology approach, the result is completely dependent upon expert decisions. Since this is the first time a quantitative upscaling of coastal function has been attempted, we quickly recognized that there are no total experts on whose judgment we can unquestioningly rely. The bottom-up approach, which we have adopted, incorporates a more realistically achievable level of expert judgment by developing tools to combine biogeochemical and related areas of expertise with the critical statistical and analytical decision making. Apart from the obvious issue of choice of variables, a typology is affected by two major factors, both of which can be guided by expert input. First, how many classes should there be in the typology? Second, how do we measure similarity between data points? The second is especially important when we consider multi-dimensional heterogeneous vectors--data points that have multiple variables with different ranges,

variances, and meanings. Cluster separation can be judged either on the basis of the distance between the means of the scaled vectors, or on the maximum difference in any variable in the set. The results are related, but lend very different weights to the types of variation observed. (8)

LoiczView allows us to analyze and visualize large heterogeneous data sets. Our process for developing and validating a horizontal (not hierarchical) typology is as follows.

1 Select the variables to use
2 Select how many classes (clusters) to create
3 Apply the VQ algorithm using an appropriate distance measure
4 Apply semantic labels to each cluster
5 Compare with expert judgement or pre-existing typologies
6 Repeat the process, with systematic variation, until a classification system is achieved that satisfies the project needs and qualitatively "makes sense" in terms of the variables used and classes identified.

A test and example:

At a recent expert workshop, we tested typology development on Australasia, which is a good example location because of the existence of both expert typologies for the region and a large number of budget sites which we can use for flux estimation (9). For our prototype typology development we use a subset of the original LOICZ data set corresponding to the Australia/ New Zealand coastline. This data set has a spatial resolution of 1 degree; the revised and updated dataset will be based on half-degree cells. Figure 1 shows the components of the expert typology and Figure 2 the similarly presented results of several different clustering tests (described below). Both figures have been simplified for small-scale black and white presentation, but the major patterns are indicated.

Variable selection was based on three factors: 1. did the variable provide good coverage of the area (<10% missing data); 2. did the variable actually provide useful information in an information/statistical sense (vary in a reasonable way over the data set); and 3. was the variable a natural 'forcing function' that would reasonably be expected to influence biogeochemical processes without giving too strong a weight to any one aspect of the environment.

We used the minimum description length principle and error plots and found the appropriate number of clusters (using the mean scaled distance) is between 10 and 15. We selected 12 classes in this example. We first used the VQ algorithm and the average scaled Euclidean distance measure to generate a set of representative classes, running it ten times and taking the lowest error result. This was done for two subsets of the data, one with 3 variables and one with 17 variables. The 17-variable set was also processed using the maximum scaled distance method. The tests are summarized in Table 1, and the results illustrated in Figure 2.

We can compare the classes identified in the unsupervised clustering of Australasia with a pre-existing expert typology to see how well the process compares. Figure 2 visually compares our 12-class typologies (3- and 17-variable mean distance, 17-variable maximum distance), in a format permitting comparison with the expert typologies presented in Figure 1. (The symbols used are intended to show general patterns and similarities, and not to suggest that the clusters in different maps shown with the same symbol are actually the same) Despite the differences in variables and methods used for the typologies, the general form of the different classes is similar, with our data-driven typology showing more detail in terms of local phenomena The biggest difference between the mean-distance and expert typologies is that a number of the localized classes in the data-driven typology do not show up in the coarser expert typology. When we compare alternative Maximum Scaled Distance (MSD) distance measure with the mean-distance approach, the biggest differences occur on the southern and northern coasts of Australia. The southern coast apparently has fewer extreme differences (but higher average differences) than the northern coast. Thus, the MSD distance does not divide the southern coast into two sections in a 12-class clustering, but the average scaled Euclidean distance does.

An important footnote to this last comparison is that using the different distance measure also causes the representational error to change, and the description length to have a different minimum--in this case one that is much larger. For the MSD method, the minimum description length analysis says that instead of 12 classes, there should be more like 24-40. When you are looking at extremes rather than averages, there are more extremes to be considered.

Table 1: Test of Australian Coastal Classification by LoiczView Clustering

Test	Clusters	Distance	Variable	Values
1	12	Mean scaled	Temperature	Annual mean
			Precipitation	Annual mean
			Runoff	Annual mean
2	12	Mean Scaled	Air temperature	Seasonal maximum and minimum
			Precipitation	Seasonal maximum and minimum
			Runoff	Annual mean
			Soil moisture	Seasonal maximum and minimum
			Evaporation	Proxy index (see note 1)
			Elevation	Standard deviation of cell mean
			Sea surface temperature	Seasonal maximum and minimum
			Salinity	Seasonal maximum and minimum
			CS Color Scanner	Seasonal maximum and minimum
			Wave height	Annual mean
			Tidal Mixing	Proxy index (see note 2)
3	12	Maximum scaled	Same as Test 2	[Note: 12 clusters is suboptimal for the maximum distance method]

Note 1: Evaporation Proxy = (wind speed)x(vapor pressure)x10

Note 2: Tidal mixing = (tide range)x(F), where F = 1 if diurnal, 2 if mixed, 3 if semidiurnal

Summary of results

The importance of these clustering experiments should not be underestimated. Not only does the process work, in an operational sense, but several key findings emerge from the results:

- The strong similarities among the expert typologies and the various clustering approaches indicate that there is robust, distinguishable 'structure' in the nature of coastal environments -- classification is both reasonable and feasible with manageable numbers of classes.
- The significant and generally understandable differences among the approaches means that we have the tools to tune and calibrate the classification approach.
- At our present budget data density, most of the major classes are represented by at least one budget site, and some have enough for statistical comparisons of the budget-coast relationship.

Where now?

We are organizing three major regional synthesis workshops to be held in 2001, leading to a global synthesis effort immediately thereafter. We know that we will not be producing "final answers," but we will be opening new territory for research, modeling, and policy applictions, and identifying what is needed -- and possible -- for the succeeding steps. At present we envision using workshops on Asia, Australia and Oceania and on the Americas and Europe to explore specific issues and approaches in the areas where we have a reasonable density of budgets (1), and to end by extrapolating the knowledge gained to classification of the data-poor coastlines of Africa and the Indian subcontinent.

LoiczView 1.3 is available in its beta version (3), and is being actively used for a variety of applications; a limited-access web-based version is in development and is scheduled to be operational in August of this year. The LOICZ half degree-cell structure is defined (2), and database assembly is proceeding rapidly. The rest of this year will be devoted to putting together tutorials, methods, and approaches to be tested and refined at the upcoming synthesis workshops.

Within IGBP, we have developed a working integration of our coastal grid and database with the BAHC (Biospheric Aspects of the Hydrologic Cycle) river basin flux typology, and we are looking forward to linking to the activities and products of LUCC (Land Use and Cover Change) and GLOBEC (Global Ocean Ecosystem Dynamics).

As we actively pursue the typology work, immediate goals include beginning the process to relating the biogeochemical budget types to the coastal types, and including more human dimension variables into the coastal classification mix.

What can you do? Join the action. We are providing templates and methods, not prescriptions or answers (at least, not yet). If you think you have a better approach -- try it. If you have a specific application or idea for use of the data and/or methods we are developing -- do it. Do you have or know of a relevant global (or even regional) dataset? Make it accessible. But above all, communicate. Peer review is vital, but the traditional paper publication is too slow. We all have to take the responsibility of working 'on-line,' properly explaining and qualifying our results, and both giving and incorporating feedback. LOICZ efforts cannot create a community -- but we can hope to connect and enable one, and that goal seems worthy of the effort.

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Nutrient budgets and modelling in South Asia

(LOICZ UNEP biogeochemical workshop, 14-17 February 2000)

LOICZ has developed over 150 site budgets describing the net metabolism and models of nutrient flux in estuarine and coastal lagoon systems globally, using the LOICZ approach developed earlier in the life of LOICZ. The target of an array of settings, in excess of 200 site descriptions, is needed if we are to make a first assessment of global changes in material fluxes and the coastal biogeochemical system responses across the salinity interface. The recent support from UNEP with GEF funding has provided a major impetus to this LOICZ effort, providing for training and evaluation workshops across most regions.

The recent workshop was generously hosted by the National Institute of Oceanography in Goa, India. It addressed coastal ecosystems in the South Asia region. Representatives from India, Bangladesh and Sri Lanka joined in the workshop of tutorial and plenary activities to train and use a variety of recently developed modelling tools, and to develop coastal site models using existing data. Relatively unimpacted to highly polluted systems were considered as working examples. The achievements and outputs will be reported in a LOICZ R&S report and placed on the LOICZ web site. It is expected that participants will continue to make contribution to this wider LOICZ effort by further assessments of nutrient transfer and fluxes in additional coastal systems from the region. This effort will be carried forward by the SAS-COM II modelling workshop to be held in Sri Lanka in September this year and being coordinated by Dr Janaka Ratnasiri.

LOIRA Project

V.V. Gordeev

The LOIRA project (Land-Ocean Interactions in the Russian Arctic) is a multidisciplinary project, devoted to investigations of the exchange processes of matter and energy and socio-economical problems in the Russian Arctic. The overall goals of the project are to develop fundamental research and ensure sustainable development of the region in a transitional period in Russia. At the start, the LOIRA Science Plan (IASC, Norway, 1997) has been basically adapted from the LOICZ and ELOISE projects to the Russian Arctic.

The project contains seven Foci: 1-coastal fluxes, 2-coastal zone permafrost, 3-terrestrial and coastal ecosystems, 4-marine ecosystems, 5-geomorphology of coastal zone, 6-carbon fluxes and 7-socio-economic development.

In the initial stage (1999-2002), the LOIRA project deals with the Pechra Sea basin and the system approach allows the choice of at least three priority Foci at this stage - Foci 1, 3 and 7. Later the project will be expanded to the eastern sector of the Russian Arctic (the Kara Sea - stage 2, 2003-2005); and the Laptev, East-Siberian and Chukchi Seas –stage 3, 2006-2009. In May 2000, the IASC Secretariat (Oslo, Norway) published the LOIRA Implementation Plan. At present the project does not have full support funding and this is being pursued.

The Third International LOIRA Workshop "LOIRA: the new approaches and methods" will be held in Moscow 5-8 December 2000, with financial support of the IASC.

Coastal GOOS Plan

Jozef Pacyna

A final session of the C-GOOS Panel was organized in Gdansk, Poland, 2-6 May 2000. The main goal of the meeting was to finalize the Strategic Design Plan for the Coastal Component of GOOS. The broad aim of the coastal component of GOOS is to detect and predict the effects of changing inputs of energy and materials from terrestrial, atmospheric, oceanic, and anthropogenic sources on coastal marine and estuarine ecosystems and the human populations that live, work and recreate in coastal environments.

The Plan contains several sections describing:

- the initial observing subsystem with selection of core variables and observing systems,
- communication network and data management subsystem with description of data policy,
- infrastructure,
- provision and evaluation of data services,
- modeling and applications subsystem, and
- description of 5 pilot projects in various parts of the world.

The Plan will be available in its final version later this year.

There are various scientific and policy issues which should be considered jointly by C-GOOS and LOICZ. The knowledge and techniques to study budgets of C, N and P in local ecosystems and on regional to global scale, developed by LOICZ, are of crucial importance to the development of C-GOOS. On the other hand, C-GOOS will provide much of the data and modeling capabilities required to predict changes in the biogeochemical budgets and to extrapolate results to coastal ecosystems that are not the subject of LOICZ. It was concluded that C-GOOS will promote the use of new knowledge and technological advances (sensors, models, data management) generated by LOICZ for applied purposes. It will also provide the framework of observations required to extrapolate research results to coastal systems that have not been the subject of an in-depth LOICZ study.

Focus 4 Human Dimensions Developments

Prof. Bob Costanza has agreed to lead the further development of Focus 4 activities in LOICZ. He will be strongly supported by other SSC member, especially Profs. Peter Burbridge and Jahara Yahara, in adding to the vital work on socio-economic assessments in LOICZ that have been produced through Prof Kerry Turner's contributions.

The IGBP historically has focussed on elucidating the global changes in biogeochemical processes and systems of planet Earth. In recent years, there has been an increasing awareness and emphasis placed on the human elements of these changes – indeed, there is clear recognition that the human factors must be an integral part of the program. Hence, the structure and objectives of the "younger" IGBP core projects, such as LOICZ, GLOBEC and LUCC, interweave the "people" aspects into their core work. In addition, close working association has been developed with global programs addressing the human dimension, especially the International Human Dimensions Programme (IHDP).

While most recognise that the IGBP program to assess biogeophysical change is challenging, the evaluation of the human dimensions of change – measurement, methodologies, concepts – is an equally difficult arena in itself. Further, the tools to integrate "people" effects with the natural world are still rudimentary. Under Kerry Turner's earlier tutelage, LOICZ has made some major steps towards meeting and resolving these scientific difficulties (see LOICZ R&S Report No. 11, 1998). The work of the SARCS-WOTRO-LOICZ South East Asian project Phase I has been a significant contribution.

As LOICZ moves further into its global assessment of changes in material fluxes and extends into its integration and synthesis phase over the next two years, we are giving greater emphasis to answering questions such as: "What are system change implications on socio-economics and human welfare? How can our science contribute to ensuring societal future in the face of global change in the coastal zone? What are the management decisions needed to ensure human benefit?

These and related issues were subject of discussion at the recent LOICZ Executive Committee meeting and new projects and approaches are foreshadowed for resolution by the LOICZ SSC later this year. In the meantime, a number of LOICZ scientists have been planning and gaining support for allied research, for example, through new projects on sea-level rise and regional capacity building workshops.

Importantly, we are increasingly trying to integrate the human dimension into the material flux measurements and process evaluations. This is at the core of the regional river catchment analyses presently underway. Adding to this, LOICZ is supporting a new project within Bob Costanza's laboratory evaluating the implications of changes in material fluxes in the coastal zone on ecosystem services. The work will link the material flux models with ecosystem services. This will allow us to estimate the changes in ecosystem services and their value based on changes in material balances caused by changes in land-use in coastal watersheds and other human-induced effects.

Funding Successes Support LOICZ

Recently further funding has been obtained from the Asia Pacific Network for Global Change Research (APN) and from the US National Oceanographic Partnership Program/Alfred P. Sloan Foundation to support LOICZ activities and LOICZ related projects.

LOICZ depends on information from nationally-supported research projects that individual researchers and agencies obtain. The LOICZ IPO and many of our global activities aimed at integrating relevant coastal science is underpinned by the Dutch government commitments to the core project. However, for new research and regional studies we rely upon funding "won" from agencies which support international and regional scale research. LOICZ actively seeks such funding support, directly or in association with contributing researchers and research groups. A major success in 1999 was the start of the UNEP GEF project (The Role of the Coastal Ocean in the Disturbed and Undisturbed Nutrient and Carbon Cycles; 1999-2001). This is estimating the changes and impacts of nutrients and carbon flux in the coastal oceans from empirical biogeochemical models of local coastal systems which assess their state of eutrophication and using up-scaling methods to gain a global picture. (see lead article)

The recent APN funding will support new research, capacity building and regional assessments vital to LOICZ and often are collaborative activities with other projects, such as IGBP START. The supported projects include:

APN Funded

i) International Human Dimensions Workshop 2000 – Human Dimensions Issues in the Coastal Zone. The workshop for younger researchers from developing countries in the Asia Pacific region will address the driving factors of global environmental change in the coastal zone, the vulnerability of society to projected changes, and the possible response options (PI: A/Prof Nick Harvey; with IHDP).

ii) Training Workshop for Capacity Building and Networking in the Area of biogeochemical Budgeting and Socio-economic Modeling in the Coastal Systems of South Asia. The training workshop will focus on biogeochemical budgeting and coastal zone socio-economic modeling for active scientists through a mixture of tutorials, hands-on training and active modeling. It will further build the network of South Asian coastal scientists. (PI: Dr Janaka Ratnasiri, with START SASCOM).

iii) APN/SURVAS/IGBP Joint Conference on Coastal Impacts of Climate Change and Adaptation. The Conference will synthesis and aggregate existing studies on the impacts of sea-level rise and climate change in the Asia Pacific region, contributing to the global database for coastal vulnerability being developed by the SURVAS (Synthesis & Upscaling of Sea-level Rise Vulnerability Assessment Studies PI: Dr Robert Nicholls) project. The capacity and possible measures for adaptation to coastal impacts in the region will be considered. (PI: Prof Nobuo Mimura, with SURVAS)

iv) Recent Sea-level Change and Coastal Management Implications for Oceania. The project will examine existing evidence and collect new data on recent sea-level changes, assess the coastal response to these sea-level variations, and will provide useful analogues for adapting current management practices in the Asia Pacific region. Capacity building and collaborative work with coastal zone managers and policy makers will be key elements (PI: A/Prof Nick Harvey)

NOPP Funded

The NOPP project funding was awarded to Prof Daphne Fautin for the project: "Biogeoinformatics of Hexacorallia (Corals, Sea Anemones and other Allies): Interfacing Geospatial, Taxonomic, and Environmental Data for a Group of Marine Invertebrates." The project contributes to the Ocean Biogeographical Information System topic of NOPP which aims to provide an individual selecting any area or volume of water on a global map to bring up information on what has been reported to live there. A fundamental part of the project is the application and further development of the typology approach that has been a core activity of the LOICZ team led by Dr Bob Buddemeier. This project should yield strong mutual benefit to NOPP-OBIS and LOICZ.

South Asia Modeling workshop

The Sri Lanka National Committee of IGBP will host the Regional Training Workshop on Biogeochemical Budgeting and Socio-Economic Modelling for Coastal Scientists to be held 18-22 September, 2000 in Colombo, Sri Lanka. It is organized in association with the South Asia Committee (SASCOM) of START and LOICZ, and sponsored principally by the Asia-Pacific Network for Global Change Research (APN).

Many countries in the region have developed or are in the process of developing coastal zone manage-

ment plans. It is important that coastal environments are managed in a sustainable manner for which it is essential to adopt an integrated approach involving the physical environment and the socio-economic aspects. In order to achieve a better understanding of the coastal zone processes and their interactions, physical observations need to be supported by modelling of these processes. LOICZ has developed methodologies for carrying out these exercises, which could be applied in different geographical areas. These include both biogeochemical budgeting models and socio-economic models and models for integrating the two.

The objective of the Workshop, in particular, is to train the coastal scientists in the use of current methodologies including computer models, enabling them to:

- Achieve a better understanding of the processes and improved capability of modeling sediment dynamics and biogeochemistry of coastal systems comprising estuaries including deltas and lagoons,
- Assess the economic and social impacts of global climate change in the coastal aquatic systems and the extent to which measures for mitigation and adaptation to such impacts would affect the coastal human populations,
- Assess the impacts of human activities of economic importance being undertaken in the coastal zones, on the coastal environs and ecosystems, and the biogeochemical budgets, and
- Integrate the natural sciences with the socio-economics for proper management of coastal zones.

The resource persons will comprise senior scientists actively engaged in coastal modeling studies. The programme will include tutorial sessions, plenary sessions and 'hands-on' training sessions. The 'hands-on' sessions will allow participants to either work with their own data to develop budgets and models, or to work through case studies provided during the sessions.

The Workshop will be limited to active coastal scientists in the member countries of SASCOM and recommended by the national SASCOM members. It is envisaged that each country will nominate scientists familiar with some aspects of Biogeochemical monitoring/ modelling or socio-economic modelling, who are prepared to undertake studies using the methodologies introduced at the workshop. The participating scientists are encouraged to form a nucleus to establish a regional research network among active coastal researchers in the South Asian region, which is one of the goals of START.

APN/SURVAS/LOICZ Joint Conference on Coastal Impacts of Climate Change and Adaptation in the Asia-Pacific Region

14-16 November 2000
APN Center, Kobe, Japan
Asia-Pacific Network for Global Environment Research (APN) and Science Council of Japan

The Asia and Pacific region is a focus for impacts of climate change and sea-level. However, the linkage between global climate change and societal impacts, and the feasibility of adaptation are poorly understood. It is also questioned how the present environmental problems and development practices are related to the future threats. The Synthesis and Upscaling of Sea-Level Rise Vulnerability Assessment Studies (SURVAS) project is synthesising and aggregating national vulnerability assessments and building networks through regional workshops to increase the knowledge base on coastal vulnerability and hence to support integrated assessments and policy making. In Asia and the Pacific, LOICZ has focussed on the economic and social impacts of global change on coastal system among other subjects.

The APN/SURVAS/LOICZ Joint Conference on Coastal Impacts of Climate Change and Adaptation in the Asia-Pacific Region will bring all the relevant researchers and policy-makers in this field to develop a comprehensive understanding on the national and regional vulnerability to climate change and sea-level rise, and possible adaptation strategies. The meeting will be attended by 70 experts including about 20 invitees from developing countries in the region.

Key objectives are:
- To synthesize and aggregate the country studies on the impacts of sea-level and climate change.
- To examine the capacity and possible measures of adaptation to the coastal impacts in the region.
- To share the results of country studies and IGBP/LOICZ studies in Asia and the Pacific with other regions in the SURVAS project.
- To develop a global database for coastal vulnerability.
- To enhance networking of the researchers in the region to promote the scientific basis for the capacity building and the policy making process in terms of the mitigation and adaptation of climate change.

Provisional schedule:
September: Deadline of abstract (1p.), and program determination
October: Submission of National synthesis results
November: APN/SURVAS/LOICZ Joint Conference
February 2001: Proceedings of the Conference

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HAVE YOU SEEN.....

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LOICZ PUBLICATIONS

[Available as printed copies or from the LOICZ web site: www.nioz.nl/loicz/]
LOICZ OSM4. 1999. Conference Proceedings of Open Science Meeting, Bahia Blanca, Argentina, November 1999. Eds. C.J. Crossland, H. Kremer and J.I. Marshall Crossland.

Estuarine Systems of the South China Sea 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. 14.

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/)

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

LOICZ CALENDAR

- AfriBasins I workshop on catchment/ coastal fluxes and human dimensions. 23-27 July 2000, Nairobi, Kenya *(by invitation).* Contact LOICZ IPO
- LOICZ-UNEP Sub-Saharan Africa workshop on biogeochemical modelling of estuarine and coastal systems. 12-14 September 2000, Zanzibar *(by invitation).* Contact LOICZ IPO
- APN-START-LOICZ regional training workshop on biogeochemical budgeting and socio-economic modelling. 18-22 September 2000. Colombo, Sri Lanka *(by invitation)* Contact: Dr Janaka Ratnasiri, (janakara@slknet.lk)
- IGBP LOICZ water/sediments workshop. 25-27 September 2000. Boulder, Colorado, USA *(by invitation).* Contact: Dr James Syvitski (syvitski@stripe.colorado.edu)
- LOICZ SSC Meeting, 3-6 October 2000, Arcachon, France. *(by invitation)*
- 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. December 2000. Hong Kong *(by invitation)*. Contact: LOICZ IPO
- LOIRA Meeting. 5-8 December 2000. Moscow, Russia (see LOIRA article). Contact: Dr V.V. Gordeev, (gordeev@geo.sio.rssi.ru)
- LOICZ UNEP Asia and Oceania 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)*

OTHER MEETINGS

- International training workshop on Integrated Coastal Area Management and its integration with Marine Sciences. 25-30 September, St. Petersburg, Russia. Contact: ggg@sici.ru
- The Third World Fisheries Congress. 31 October-3 November 2000, Beijing, P.R. of China.
- IGBP Open Science Conference. 10-14 July, 2001, Amsterdam, The Netherlands. Contact: igbp@congrex.nl
- Joint IAPSO-IABO Assembly, Mar del Plata, Argentina, 21-28 October 2001. Contact: gmperill@criba.edu.ar

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