

# LOICZ NEWSLETTER

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

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**Introduction**

In the global context of coastal zone management, policy responses at all levels of governance and society needs to become more adaptable to cope with socio-economic and environmental change, including sea level rise. The future will always be shrouded by uncertainty and therefore accurate prediction is not a feasible goal. However, it is possible to formulate scenarios, which can shed light on and offer insights about possible future developments. The information generated by such an approach can assist policy makers in searching for efficient, effective and equitable coping strategies and policy options for integrated and sustainable coastal zone management. This paper investigates the use of scenarios for integrated catchment/coastal zone management in the Humber Estuary, in the U.K. The context of this ongoing research is the EuroCat project, which aims to assist in integrating catchment and coastal zone management by analysing the response of the coastal sea to changes in fluxes of nutrients and contaminants from the catchments. This article looks at principles of Integrated Environmental Assessment, the use of scenarios, and how national scenarios can be adapted to the regional level to focus on three possible futures for the Humber. An overview is given of future research and how the scenarios can be used to simulate future fluxes and



This is the twenty-third 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

provide a consistent framework to evaluate potential policies to improve water quality in the estuary.

**Integrated Environmental Assessment (IEA)**

IEA should adopt “a synoptic perspective with two characteristics:

- (1) integrated assessment should have value added compared to single disciplinary oriented assessment;
- (2) integrated assessment should provide useful information to decision makers.” (Rotmans *et al.* 1996)

IEA can be summarised as a continuous “process” which is conditioned by a policy and/or management context and is characterised by its cyclical nature with multiple feedback effects and requirements. It not only provides a conceptual framework, it is a “team-

based” learning process for experts and decision makers, and in its most inclusionary form, other types of stakeholders, enabled via inter/multi/trans-disciplinary research, using a toolbox of complementary analytical methods and techniques.

While it is important that the different contributing disciplines know something about each other’s methodology and approaches to scientific investigation, it is more significant that each contributor to IEA maximises their knowledge of the policy/management context at issue (Harremoes and Turner 2001) and contributes to the dialogues that must take place if IEA is to be socially relevant.

**Scenarios**

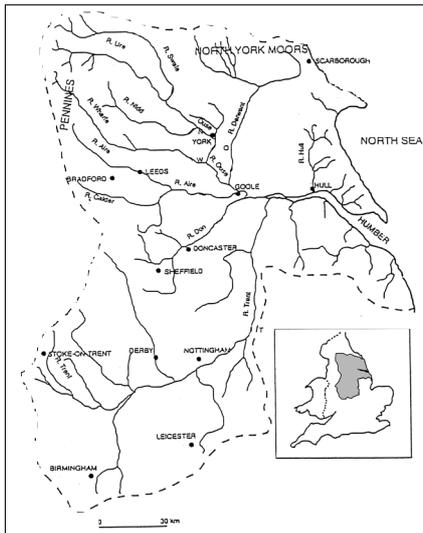
A scenario can be defined as a coherent, internally consistent and plausible description of a possible future state of the world. It is not a forecast because it cannot assign probabilities to any particular outcome. Instead, scenarios portray images of how society and its supporting environment could look like given different sets of assumptions and consequent conditions. The implicit rationale is to evolve better procedures for coping with future ‘surprises’, by forcing analysts to think laterally and radically. Scenarios typically contain qualitative storylines augmented by varying amounts of quantified data. They can be informed by relevant history but not conditioned by it, except in the case of so-called baseline or ‘business as usual (BAU)’ scenarios. The latter can be utilised as benchmarks against which to portray other possible states of the world and are compiled with the aid of trend data. In practice, scenarios will combine a range of features depending on their real world application and the scale at which they are pitched.

Scenarios may possess a variety of characteristics and can be deployed at different spatial scales and across different temporal scales (typically from 10 years to 100 years). They can be used to facilitate consensus, or negotiation, in situations where multiple competing stakeholder interests are at issue; or at least provide part of a more inclusionary process for decision-making.

They can be focussed on particular policy objectives and/or instruments and provide sensitivity assessments. Finally, they can portray the consequences of policy strategies that incorporate radically different world-views in a more visionary way. In this context the 'alternative' visions are most often reflected against a baseline (BAU) trend scenario.

### The Humber Estuary and Coastal Zone

The Humber catchment covers an area of ca. 24,240 km<sup>2</sup>, more than 20% of the land area of England. Its freshwater input is the largest of any British Estuary to the N. Sea. The catchment comprises the drainage basins of the rivers Trent, Ouse, Ancholme and Hull, which drain into the inner and outer estuary, respectively (Figure 1).



**Figure 1. Humber Catchment** (adapted from Edwards et al., 1997) Inset map of England and Wales, showing the extent of the Humber catchment in grey.

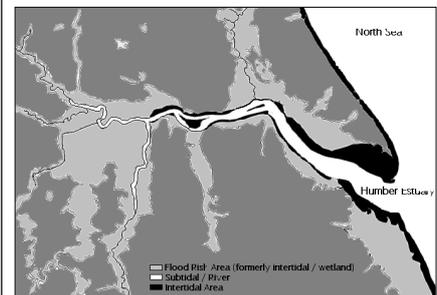
The Humber catchment is home to 20% of the UK population, and a very significant proportion of the energy, industrial and agricultural production.

Industrial and agricultural development over the last few hundred years have adversely impacted the quality of the water entering the estuary from the rivers. The principal industries impacting on water management are coal mining, electricity generation, food processing, steel and non-ferrous metals, engineering, chemicals, textiles and waste disposal.

The macro-tidal Humber estuary is one of the largest in the UK, with a maximum tidal length of 147 km from Cromwell Weir on the Trent to the Humber's mouth, and maximum width of 15 km, comparable with the Thames and Severn Estuaries (Andrews *et al.* 2000). The area surrounding the Humber Estuary (Humberside) is mainly high quality agricultural land, with many thousands of hectares reclaimed from the estuary over the last few centuries. As a result, it is estimated that over a third of a million people now live on areas of land below high spring tide level. Approximately 570 km<sup>2</sup> of land would be flooded if the present extensive coastal defences were removed. Humberside ports handle 17% of the UK's sea-borne trade, Grimsby Immingham being now the largest port complex in the UK. In spite of extensive reclamation and coastal squeeze over several centuries, large areas of intertidal and coastal wetland habitat still exist in the estuary, supporting year-round bird populations, as well as migratory species and winter residents. The outer estuary is an important fish nursery area for North Sea plaice. Much of the Humber is designated under the Habitats Directive, and the entire Estuary has been proposed as a marine Special Area of Conservation, in recognition of its importance to nature conservation.

The Humber case study represents a good example of what can be called a "mature" environmental problem. Over the last few decades, as heavy industry in the catchment has declined, and regulations on emissions and inputs to controlled waters have become more stringent, the water qualities of both catchment and estuary have improved. The "peak" nutrient loading and metal inputs to the Humber estuary from the near-estuary and wider catchment

zones is in the past. However, a legacy of contamination still exists in the sediments, and the loss of intertidal area (Figure 2) has reduced the filtering capacity of the estuary for nutrients, which instead get exported directly to the North Sea. It is estimated that up to about 300 years ago, the Humber estuary acted as a sink for all the riverine inputs of dissolved inorganic nitrogen (DIN) and phosphorus (DIP), and was a net importer of DIN and DIP from the North Sea. In the present-day estuary, >95% of the DIN and >10% of the DIP is exported to the Sea, due to an order of magnitude reduction in the sedimentation within the estuary following the loss of intertidal area (Jickells *et al.* 2000), rather than simply to the increase in inputs from anthropogenic changes.



**Figure 2. The modern Humber Estuary.** The black area indicates present-day intertidal area, the light grey area represents original intertidal area (ca. 3000-300 years ago), prior to any reclamation; this area is currently below the level of high water spring tides and is protected by coastal defences (modified from Andrews *et al.* 2000).

### Integrated Assessment, Scenarios and the Humber

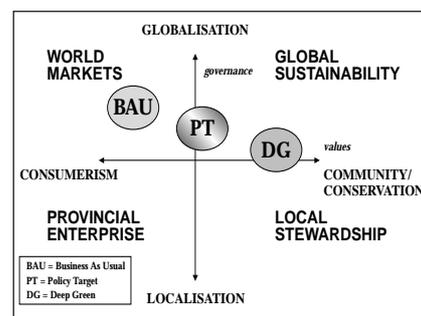
To help reduce uncertainty and aid decision-making, it is useful to focus on distinct and radically different possible futures for the Humber. Feasible scenarios for the Humber were adapted from existing scenarios pitched at the national level and developed to cast light on future social, economic and environmental trends for the UK over the period 2000-2040 (OST 1999).

The OST national scenarios are framed by two orthogonal axes, representing societal values (ranging from consumerist, self-interested market-based

preferences to collectivist and conservationist social preferences) and level of effective governance (from local to global) respectively (Figure 3). These axes determine four futures, which, for simplicity's sake, appear as independent possible states of world. In reality, the boundaries are fuzzy and the different states are differentiated because certain trends and characteristics become more or less dominant across government, business and public social contexts. World Markets, for example, is the equivalent of a baseline (almost trend) scenario. It is meant to portray conventional industrial/international capitalism continuing out into the foreseeable future. Sustainable development is interpreted in its 'weak sustainability' form (Turner *et al.* 1998; Burbridge 2001). This scenario is characterised by a requirement to maximise total output (GDP), with widening income inequality. Environmental concerns are important but constrained to 'local' health and/or amenity concerns; international environmental agreements have relatively modest targets/standards. The Global Sustainability scenario, believes that environmental systems are often of infinite value and are the foundations of a sustainable economic and social system, not vice versa. Resource use efficiency/ productivity can be radically improved via a mixture of regulation, economic incentive mechanisms and technological innovation. Sustainable development requires the redressing of global inequities of income and wealth, as well as efficiency gains. A move towards more globalisation of governance systems is supported. The remaining two possible futures are described in OST (1999)

Three regional variants were derived from these four national scenarios and adapted to the Humber (Figure 3). The *Business As Usual* scenario is the baseline scenario, corresponding roughly to the World Markets scenario at national level. It is a forward projection of the past 20 year trends in data, ignoring the recent sustainable development strictures. In this scenario, current legislation is only complied with in a formal way. For example, expected port expansion within the Humber estuary over the next 20-25 years would lead to a loss of 0.2% of the intertidal area in

the Humber estuary, approx. 20 ha. In terms of flood defence around the estuary, hard defences would be maintained as far as possible, exacerbating the problem of coastal squeeze. Given the commitment of the UK to implement the Habitats Directive, compensation in the form of recreated habitats would have to be provided, but one could assume that this would be on the basis of minimum compliance. One would therefore expect a net loss of habitats in this scenario. Water quality objectives are likely to include exceptions for a variety of polluting industries. The standard of sewage treatment is likely to be relatively low (up to recently, there was no treatment for the large, direct sewage discharges in the tideway). At the catchment level, agriculture is likely to remain relatively intensive and rely on technology (e.g. GM crops) to sustain high yields, leading to no net reduction in nitrate input to rivers. Contaminant concentrations would also remain at their current level.



**Figure 3. From national contextual scenarios to regional scenarios for the Humber (modified from OST 1999).**

In the *Policy Target* scenario, current and prospective legislative targets/objectives are all met on time, according to the EU schedule, with a genuine effort to comply and/or to overcomply with the objectives. The Habitats Directive is likely to be implemented in a genuine attempt to achieve zero habitat loss. This would involve compensation for loss of intertidal area by recreating equivalent or increased habitat in another area. For example, the environmental regulator is creating 80 ha of intertidal habitat at Thorngumbald, by moving back the flood defences. The scheme envisages providing compensation for several flood defence schemes having an adverse impact on designated habitats and contributing some area towards alleviating coastal

squeeze. This approach is close to the idea of "mitigation banks" or "land banks", whereby an extensive area of habitats is recreated ahead of development or natural loss, and which could facilitate the implementation of the Habitats Directive (Ledoux *et al.* 2000). In this scenario, there would be a net increase in intertidal area of 1200 ha by 2025, which would include compensation for losses through coastal squeeze. Sewage treatment around the estuary is likely to be of moderate standard, i.e. all sewage will receive secondary treatment prior to direct discharges, but there would be no tertiary treatment or phosphorus removal. In agriculture, application of fertiliser per unit area will be reduced through targeted policies, and will be timed to reduce the runoff to rivers. Overall reduction of the nutrient load from the catchment into the estuary would be approximately 50%, as foreseen by the OSPAR convention and the various international agreements on the North Sea. The current water quality standards would be met at all times for all contaminants.

In the *Deep Green* scenario, environmental protection is given maximum priority. It corresponds loosely to a state between the Global Sustainability and Local Stewardship national scenarios. This represents some environmental state beyond that which could be achieved if current policies were implemented. The economy is also likely to be more regionalized. A Deep Green scenario would involve substantial increases in intertidal areas, compensating for any new works or extension of existing installations, over and above coastal squeeze. The creation of mitigation banks in a formal and regulated setting might contribute to a strategic approach to an increase in biodiversity (Crooks and Ledoux 2000). A recent RSPB study identified 2 858 ha with potential for intertidal habitat creation within the Humber Estuary. In this scenario, intertidal habitat would increase to 2500 ha, i.e. more than double the area in the Policy Target scenario. Agriculture is likely to become less intensive. Riparian zones will be created along most riverbanks bordering farmland to reduce inputs of nutrients to rivers. Environmental schemes such as reed bed treatment will be widely

applied for secondary sewage treatment, rather than hard technology, and tertiary treatment will be widespread, removing nitrogen and phosphorus. In this scenario, the objective would be to approach "natural" background levels of nutrient and contaminant fluxes through the system.

#### **Future research: estimating future fluxes and policy evaluation**

These scenarios describe possible future regional states for the Humber. The "storylines" they utilise will facilitate the exploration of possible measures to improve water quality in the estuary, under the different economic, political and environmental circumstances associated with each scenario, and the estimation of fluxes likely to result.

Future fluxes of nutrients and contaminants in the three scenarios will be estimated using a toolbox of complementary analytical methods and techniques. This includes projections of time-series data available from work carried out during the LOIS project (e.g. Neal and Robson 2000); use of synthetic time series; interfacing of outputs from the LOIS catchment model from the Centre for Ecology and Hydrology with the ECos model for the Humber estuary from Plymouth Marine Laboratories, together with partition coefficients for dissolved-particulate interaction interaction derived from other projects (e.g. JONUS, URGENT) and sediment transport models.

In a second step, the policy options will be analysed more in depth. The scenarios will be used to generate three distinct and radical policy packages, and the implications for the estuary and its ambient quality will be investigated. A cost-effectiveness analysis will be carried out, relating the estimated costs of each policy package to the water quality objectives imposed by the Water Framework Directive, to determine the least cost options to reach these objectives. Finally, to go some way towards achieving integrated environmental assessment in an inclusionary form, stakeholders will be consulted on wider issues linked to water quality. A multi-criteria analysis will be carried out to

compare policy options by reference to an explicit set of evaluation criteria. Stakeholders will provide input in identifying possible policy packages, as well as specific criteria within three broad categories (economic, environmental, and social). They will also be asked to give weights to the evaluation criteria to determine their relative importance. The impact of each of the policy packages on the set of criteria will be assessed through scores, determined by modelling and expert opinion. Policy options will be ranked according to their impacts on the criteria, taking into account the stakeholder weights attributed to each criterion. Ultimately, the scenarios will provide a consistent framework to undertake a sensitivity analysis of how the outcome of the present-time multi-criteria analysis would change under the three different possible future scenarios.

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#### **COASTAL CHANGES AND THE ANTHROPOCENE LOICZ Synthesis and Futures Meeting Miami, May 2002**

After 9 years of collaborative research addressing Global Change in the coastal zones, LOICZ held its Synthesis and Futures Meeting at the Rosenstiel School for Marine and Atmospheric Science, University of Miami, USA. Dean Otis Brown welcomed the participants and noted that LOICZ makes an important contribution in a surrounding of largely disciplinary sciences and rather unlinked institutional structures. The Executive Director of IGBP, Will Steffen, highlighted key findings of recent global change sciences: within the last 100 or 200 years humans have had such an influence on natural systems that we should now talk about the "Anthropocene". Signals such as the increase in CO<sub>2</sub> as well as the retreat

of the polar ice cap are just a few examples. The coastal zone, the domain with a variety of most fragile habitats and home to more than 50% of the global population as pointed out by the SSC Chair of LOICZ, Han Lindeboom, is of priority concern in the context of growing natural and human pressures. The first LOICZ synthesis and the move into LOICZ II, with increasing emphasis on society-relevant research on all spatial scales but still with the priority commitment to global up-scaling, was seen to be very timely.

A group of 120 natural and social scientists from 40 countries addressed a first integrated assessment of coastal zone material flux models, processes, and human dimensions, following the outlines of the LOICZ synthesis book (newsletter 17, Jan 01):

- Coastal Habitats and Living Resources
- Water and the Coastal Zone
- Dynamics of the Coastal Zone
- Impacts and Feedbacks in C, N and P Cycling
- Science for Management

Plenaries and working groups started to distil the messages produced so far, and to identify gaps. Coastal habitats were seen to provide the frame for the other chapters reflecting the systems, their natural and human-induced variability and related value functions for environmental and societal developments. Discussions focussed on strong and weak sustainability options as a translation of scientific results into management advice. The multi-regional application of the DPSIR assessment framework has provided an overview, ranking and trend analysis of river catchment-coast interactions under human influence. Investigations of sediment and water fluxes and implications for coastal dynamics reveals the close interplay between global change and human response. Estimates consider some 8,400 km<sup>3</sup> of freshwater to be trapped behind dams, a 700% increase of water storage. This can visibly alter the material exchange between the coasts and the catchments. Groundwater delivery to the coastal zone is estimated to be about 5-6% of the global river flow (37,000 km<sup>3</sup> y<sup>-1</sup>). C, N and P cycling has been modelled

in more than 200 sites and key findings support a relatively simple proxy for coastal loading in population density in catchments. A bimodal distribution of net-metabolism characteristics has been found. One challenge will be to find thresholds for loads that make systems flip either temporarily or in general. Global data sets have been acquired that make the typological up-scaling approach applicable for assessment of areas with limited data coverage.

The second task of the Meeting was to consider the future design of LOICZ, with a continuing role in IGBP II and contributing to the Earth System Science Partnership of IGBP, IHDP, WCRP and DIVERSITAS. Sessions were built around the preliminary thematics identified in the "LOICZ Futures discussion paper" (Version 7):

- River Basins and Human Dimensions
- Spatial Issues: Implications of Land Use Changes in the Coastal Zone
- Fate and Transformation of Materials in Coastal and Shelf Waters
- Towards System Sustainability and Resource Management
- Risk and Vulnerability

Introductory plenaries from other related projects planned or implemented by IGBP (Oceans, SOLAS, Land) provided a focus for discussion of LOICZ future directions. Institutional perspectives by the European Commission, the IAI, and UNESCO/IOC gave a client's view of LOICZ science and products. Further insight was given into current and potential applications of LOICZ science by representatives of the Coastal GOOS (Global Oceans Observation System) of IOC and the EU 6<sup>th</sup> Framework Programme. The immediate relevance of river basin/coastal sea assessment scales was supported and the implications for policy advice (EU water framework directive), were highlighted.

A principal outcome of the discussions was an overall consensus on the proposed thematics and cross-cutting activities (scaling, variability, dissemination and acquisition). The outcomes and advice of the Meeting will add to the development of a LOICZ II Science Plan into 2003. Throughout,

the point was made that a stronger involvement of human dimension disciplines, stakeholder participation and coupling of natural and social science perspectives would be crucial.

Allocation of value functions to coastal zones and habitats along with assessment of non-marketable goods and services were identified as valid needs in the future LOICZ. River basins were seen to provide an important scale for action and assessment.

The LOICZ coastal typology methodology and approach was seen as having a high potential for application across national and regional levels. Key issues for a future LOICZ Science Plan in the context of the Earth System and its change include altered hydrology and sea-level rise on global scales, climate change in polar regions, eutrophication in temperate regions and soil erosion in tropical regions.

Meeting presentations and posters will be available on the LOICZ web-site in the next few weeks. A Meeting report will be published soon. The LOICZ SSC is grateful for the constructive input provided by all participants, for organisation by RSMAS and funding support from IAI, IGBP IOI, KNAW, NSF, UNESCO/IOC, START and WOTRO.

## LOICZ IPO NOTES

Currently, LOICZ efforts are much focussed on the development and writing of the LOICZ Synthesis to be contained in a text describing the research that the global community has developed over the last 9 years to answer a series of global change questions. The outcomes from the recent Miami meeting, described earlier, have contributed greatly to this effort. While we continue with this challenging synthesis task, LOICZ IPO and a number of the LOICZ network of scientists have been planning for the new LOICZ programme of activities as part of the evolving IGBP programme, with LOICZ II scheduled to start in January 2003. The Futures work is engaging with a number of national scientific groups to establish nodes across the world regions and to continue to build out new projects.

### LOICZ Futures and Human Dimensions

An important element for the new LOICZ direction is to closely engage with the human dimensions scientific fraternity, especially through the International Human Dimensions Programme (IHDP). Recognising that more than half of the world's population lives in the coastal zone and that humans are increasingly affecting the global processes, the imperative for a strong natural and socio-economic scientist collaboration in the new LOICZ programme is obvious. This development was enthusiastically endorsed at the Miami meeting and we are increasingly involving sociologists, economists and institutional researchers in the LOICZ Futures planning.

In early June LOICZ representatives joined with regional scientists in a symposium in Bali on the Exclusive Economic Zone in the Asia Pacific. This included a wide-ranging discussion about the effect of EEZ institutional arrangements and its impact on sustainable development, fostered by the IHDP Institutional Dimensions of Global Environmental Change (IDGEC). The opportunity was taken to discuss collaboration and potential joint research projects with IDGEC and we look forward to close working relationships as we proceed into the new LOICZ programme.

In addition, the LOICZ SSC resolved that a working group be established to develop a new Science Plan (2003-2012). Working group membership is expected to include a mixture of "natural" scientists and human dimensions scientists to develop the Plan over the next 12 months. A current LOICZ Futures Discussion Document will form the platform for this development; contact the LOICZ IPO if you have not received a copy of the Discussion Document. We are seeking a wide input to the development of thematic research areas, issues, and directions and would greatly appreciate your advice and comments.

### LOICZ SSC

The SSC met over two days in association with the LOICZ Synthesis and Futures Meeting in Miami. The preparation of the LOICZ Synthesis was

a major point of discussion. Consideration of the future plans and a modified structure for LOICZ operations were key items, with resolution of directions building on the outcomes of the Miami S&F Meeting. Future funding, a distributed IPO and improved regional representation and node points were evaluated and plans for improved communications within the planning and implementation of the new LOICZ program were developed. Further information will be available on the LOICZ web-site in the immediate future.

### New Projects

A number of new projects have been received as contributions to the current LOICZ efforts and will extend into the new LOICZ programme. The Netherlands government has established five new research projects as part of its € 3.17 million LOICZ programme, including:

Transport of suspended particulate material in the Dutch Coast (Dr H. Ridderinkhof, NIOZ);

Archaeal carbon fixation and burial and terrestrial organic matter input in the coastal system as revealed by tetraether membrane lipids (Dr J.S. Sinninghe Damste, NIOZ);

Bio-geomorphological interactions within floodplains and their role in sediment transport and ecological transformation processes in the lower Rhine delta (Prof E.A. Koster, Utrecht, Univ.) Mechanisms involved in salt marsh rejuvenation (Prof. J.P Bakker, Groningen Univ.)

Budgeting of carbon and related nutrient pools and fluxes in the North Sea employing a coupled hydrodynamic ecosystem model (Dr Helmut Thomas, NIOZ).

A call for projects addressing human dimensions research in the coastal zone will be made later this year.

Two new EU-supported projects have been approved: DINAS-Coasts (modelling natural and socio-economic impacts of accelerated sea level rise, <http://www.pik-potsdam.de/~richardk/dinas-coast/>), and ALIENS (Algal Invasions in European Shores – for more information go to <http://www.cordis.lu/eesd/ka3/cluster5.htm>) that have a strong relationship with LOICZ science.

The EU-sponsored EuroCat project has been extended to include the Idrija River (Gulf of Trieste) and the Prova-diiska River (Bulgaria) draining to the Black Sea (<http://www.ia-cnr.unical.it/EUROCAT/project.htm>).

The European Commission is in the process of opening the new 6<sup>th</sup> Framework programme for research. There are two new categories of proposal: integrated mega-research projects (ca. € 20-30 million – at least three partners, duration three to five years) and networks of excellence (at least 6 partners, duration five or more years). Both areas have attracted strong interest from the LOICZ community and several expressions of interest have been submitted. Further information on these developments can be seen at (<http://europa.eu.int/comm/research/fp6/networks-ip.html>).

### Si transformations along the Land-Ocean Continuum:

6 PhD and 6 post-doctoral positions will be available from October 1, 2002, within the framework of the Si-WEBS Research Training Network. Si-WEBS (Natural and Anthropogenic perturbations of the Silicon cycle: Worldwide Ecological, Biogeochemical and Socioeconomic consequences) is a network funded by the European Commission. Details of the work programme, positions, and additional eligibility conditions for young researchers can be found at the Si-WEBS web-page:

<http://www.pangaea.de/Projects/Si-WEBS/> For further information, please contact: Olivier Ragueneau, [Olivier.Ragueneau@univ-brest.fr](mailto:Olivier.Ragueneau@univ-brest.fr)

### New address – Stephen V. Smith

Prof. Stephen V. Smith, well-known to most of the LOICZ community for his Focus 3 leadership and co-mentoring (with Prof. Fred Wulff) of the biogeochemical and budgeting work in LOICZ, is moving from Hawaii to Ensenada, Mexico. His new contact details are:

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### The DINAS-COAST Project

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Over the past decade, extensive research has been produced to assess coastal vulnerability to impacts of accelerated sea-level rise from local to global perspectives. National studies have been commissioned for example by the US Country Studies Programme and the Netherlands Climate Change Studies Assistance Programme. Interpretation of local/national results is, however, constrained by the fact that these studies used a range of methods, scenarios and assumptions. Throughout the 1990s, a first evaluation of coastal impacts and adaptation at regional and global scales was developed via the Global Vulnerability Assessment Framework (Hoozemans et al., 1993). DINAS-COAST will update and improve this early effort to satisfy current information needs for international climate policy.

DINAS-COAST is a top-down modelling efforts which builds on state of the art science and data to help policy makers to interpret and evaluate coastal vulnerability to impacts of accelerated sea-level rise, and adaptation options. The project will develop DIVA (Dynamic Interactive Vulnerability Assessment) which will allow the user to produce quantitative data:

- on a range of coastal vulnerability indicators,
- for user-selected climatic and socio-economic scenarios and adaptation policies,
- on national, regional and global scales, covering all 180+ coastal nations.

DIVA will enable its users:

- to explore the effects of, on the one hand, climate change mitigation and on the other, adaptation in coastal zone,
- to explore potential cost-effective policies that combine mitigation with adaptation,
- to set priorities for international cooperation with respect to climate change and development, and

- to identify particularly vulnerable coastal areas and allow for the evaluation of a range of alternative responses.

DIVA will be a valuable tool for training and awareness raising. Its resolution will not allow coastal managers to make decisions at their scale of operation. However, DIVA will provide insight into the sensitivity of the coast to climate change and will thus be useful in informing coastal managers and national and international policy makers of the issues at stake in relation to climate change, coastal impacts and adaptation strategies.

The DINAS-COAST (**D**ynamic and **I**nteractive **A**ssessment of National Regional and Global Vulnerability of **C**oastal Zones to Climate Change and Sea-Level Rise - EVK2-2000-22024) project is funded by the European Commission under the 5<sup>th</sup> Research Framework. It is led by Richard Klein (Potsdam Institute for Climate Impact Research, Germany). Four other partner institutes collaborate within DINAS-COAST (Flood Hazard Research Centre, UK; Hamburg University, Germany and WL Delft Hydraulics and the Centre for Environmental Studies, The Netherlands). For more information of the project, please log on our website: <http://www.PIK-Potsdam.DE/~richardk/dinas-coast/> or contact Dr. Anne C. de la Vega-Leinert at [delavega@pik-potsdam.de](mailto:delavega@pik-potsdam.de)

#### Reference

**Hoozemans, F.M.J., Marchand, M. and Pennekamp, H.A.** (1993): *A Global Vulnerability Analysis, Vulnerability assessments for population, coastal wetlands and rice production on a global scale*, 2<sup>nd</sup> Edition, Delft Hydraulics and Rijkswaterstaat, Delft and the Hague.

#### HAVE YOU SEEN

Lacerda, de Luiz Drude (Ed.), **Mangrove ecosystems: Function and Management**, 2002 Springer, ISBN 3-540 422080.

For more info please contact:  
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e-mail: [ldrude@fortalnet.com.br](mailto:ldrude@fortalnet.com.br)

Young, Oran R., **The institutional dimensions of environmental change: fit, interplay, and scale**, 2002 Massachusetts Institute of Technology, ISBN 0-262-24043-2 (hc.)-ISBN 0-262-74024-9 (pbk.)

#### WHAT'S ON THE WWWEB

Integrated Coastal Zone Management in the Venice Area. A methodological framework: <http://www.feem.it/web/activ/wp/abs01/100-01.pdf>

Integrated Coastal Zone Management in the Venice Area. Potentials of the Integrated Participatory Management Approach: <http://www.feem.it/web/activ/wp/abs01/99-01.pdf>

Integrated Coastal Zone Management in the Venice Area. Perspectives of development for the rural island of Sant'Erasmus: <http://www.feem.it/web/activ/wp/abs01/98-01.pdf>

The Water Action Unit's first part of the World Water Action draft report, to be presented at the 3<sup>rd</sup> World Water Forum in Kyoto 2003, can be downloaded from the following link for feedback and input:

[www.worldwatercouncil.org/WAU\\_intro.shtml](http://www.worldwatercouncil.org/WAU_intro.shtml)

A special website for Africa has been established by Charles Magori: [www.ioc.unesco.org/glossafrica](http://www.ioc.unesco.org/glossafrica) (e-mail: [cmagori@yahoo.com](mailto:cmagori@yahoo.com))

The Terrestrial Ecosystem Monitoring Sites (TEMS) database has recently been upgraded and includes new features such as: faster database search and access to information, four interactive eco-regional maps, local climate data from the FAO global database, an initial coastal module and many other features that are less visible but help the database run more efficiently. The updated version of TEMS is available on the web at: [www.fao.org/gtos/tems](http://www.fao.org/gtos/tems).

*The following sites are accessible via the LOICZ web-site:*

<http://www.nioz.nl/loicz>

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

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

#### Links

Basins:

[http://w3g.gkss.de/projects/loicz\\_basins/](http://w3g.gkss.de/projects/loicz_basins/)  
Deltas management:

<http://www.deltasnetwork.nl>

South Asia Coastal Fluxes:

<http://www.coastal-fluxes.slt.lk>

### LOICZ PUBLICATIONS

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

For hard copies of LOICZ R&S volumes (as long as stocks last), email: [mildred@nioz.nl](mailto:mildred@nioz.nl).

**Estuarine systems of the Latin American Region (Regional workshop V) and estuarine systems of the Arctic region: carbon, nitrogen and phosphorus fluxes.** Eds. Camacho-Ibar, V., V. Dupra, F. Wulff, S.V. Smith, J.I. Marshall Crossland and C.J. Crossland 2002, *LOICZ Reports & Studies* No. 23, ii+103 pages, LOICZ, Texel, The Netherlands

**The role of the coastal ocean in the disturbed and undisturbed nutrient and carbon cycles.** Eds. Buddemeier, R.W., S.V. Smith, D.P. Swaney and C.J. Crossland 2002, *LOICZ Reports & Studies* No. 24, ii, 83 pages + CD-ROM, LOICZ, Texel, The Netherlands.

### LOICZ/IGBP CALENDAR

15<sup>th</sup> IGBP Officers Meeting, 7-10 October 2002, Casablanca, Morocco.  
Contact: Clemencia Widlund, [clemencia@igbp.kva.se](mailto:clemencia@igbp.kva.se)

LOICZ/JGOFS Continental Margin Task Team Workshop for the Global Synthesis of the 5 Regional Syntheses, 4-6 December 2002, Washington DC, USA. Contact: Larry Atkinson, [atkinson@ccpo.odu.edu](mailto:atkinson@ccpo.odu.edu), Renato Quinones, [rquinone@udec.cl](mailto:rquinone@udec.cl) and Richard Jahnke, [rick@skio.peachnet.edu](mailto:rick@skio.peachnet.edu)

APN/START/LOICZ Regional workshop on Assessment of Material Fluxes to Coastal Zone in South Asia and their Impacts, Colombo, Sri Lanka, 9-10 December 2002.

Visit [www.coastal-fluxes.slt.lk](http://www.coastal-fluxes.slt.lk) or contact: Dr. Janaka Ratnasiri, e-mail: [janakar@itmin.com](mailto:janakar@itmin.com)

IGBP/SCOR International Open Science Meeting on Ocean Biogeochemistry and Ecosystems, January 2003, Paris, France.  
Go to: [www.igbp.kva.se/obe/](http://www.igbp.kva.se/obe/)

18<sup>th</sup> IGBP SC Meeting, 20-24 January 2003, Punta Arenas, Chile.  
Contact Clemencia Widlund, [clemencia@igbp.kva.se](mailto:clemencia@igbp.kva.se)

3<sup>rd</sup> IGBP Congress, 19-25 June 2003, Banff, Canada. Contact Clemencia Widlund, [clemencia@igbp.kva.se](mailto:clemencia@igbp.kva.se) and Charlotte Wilson, [charlottew@igbp.kva.se](mailto:charlottew@igbp.kva.se)

### OTHER MEETINGS

International Symposium on Low-Lying Coastal Areas: Hydrology and Integrated Coastal Zone Management.  
9-12 September 2002, Bremerhaven, Germany. Contact Alicia Aureli, UNESCO ([a.aureli@unesco.org](mailto:a.aureli@unesco.org)).

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

37<sup>th</sup> DEFRA Flood and Coastal Management Conference, 16-17 September 2002, Keele Conference Park, Keele University, Keele, Staffordshire, UK. Visit <http://www.defra.gov.uk/environ/fcd/default.htm> or contact Jessica Sampey by phone: +44 (0) 1782 584379 or by fax: +44 (0) 1782 713058

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

START/APN/TEA Workshop on Global Change and Sustainable Development in Coastal Northeast Asia, 7-8 October 2002, Vladivostok, Russia.  
Contact Vladimir Kasyanov, [inmabio@mail.primorye.ru](mailto:inmabio@mail.primorye.ru)

2<sup>nd</sup> GLOBEC Open Science Meeting, 15-18 October 2002, Qingdao, P.R. China. <http://www.pml.ac.uk/globec/>

34<sup>th</sup> COSPAR Scientific Assembly and Second World Space Congress, 10-19 October 2002, Houston, Texas, USA.  
Visit: <http://www.copernicus.org/COSPAR/COSPAR.html>

QUASIMENE Conference: Measurements in the marine Environment: Challenges and Achievement, 23-26 October 2002, Barcelona, Spain.  
Visit: <http://www.iaea.org/monaco> or email [S.de\\_Mora@iaea.org](mailto:S.de_Mora@iaea.org)

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Estuaries, or transitional waters, represent the transition between freshwater and marine environments and are influenced by both aquatic realms. Salinity levels are indicative of the position within the mixing zones of an estuary. The upper limit of an estuary is referred to as its head, while the lower limit is called the mouth of the estuary. Between the freshwater head and the saline mouth of the estuary lie a number of zones marked by intermediate salinity values, each with distinct