## Appendix I Workshop Report

### Welcome

Participants (Appendix II) were welcomed to the workshop venue at the National Centre for Marine Research, Athens Greece by the Director of the Institute of Marine Biological Resources, Dr K. Papakonstantinou, and local coordinator, Dr Christos Anagnostou. Support arrangements and the purpose of the workshop were outlined. The agenda (Appendix III) was introduced and working documents, diskettes and CD-ROMs of support and tutorial materials were distributed to participants.

### Introduction and Biogeochemical Tutorials

An introduction to the LOICZ Core Project of IGBP by Dr Chris Crossland provided a context of goals and approaches being undertaken to describe global changes in materials fluxes in the coastal zone, and a framework for the workshop activities. The EU ELOISE program was reviewed in the context of the LOICZ project. A comprehensive description of the LOICZ biogeochemical budgeting approach by Prof. Fred Wulff, and the planned interpolation of local scaled information to global scales within LOICZ and to regional scales within ELOISE gave a foundation for the workshop enterprise. A detailed tutorial addressed key elements and tools available to researchers for the derivation of C-N-P budget models and estimation of net metabolism of coastal systems. These included:

- Biogeochemical budget construction and calculations (Vilma Dupra). A short manual on budget calculations was distributed;
- LOICZ Biogeochemical Budgets and Models web-site contents and development (Dennis Swaney);
- Introduction and description of a tool developed for use in site nutrient budget calculation – CABARET software (Dr Laura David). Diskette copies of the software were provided to all workshop participants; and
- Waste load estimation and relationships and river discharge calculation were described (Dr Laura David). Relevant software was distributed. It was noted that the tool for river discharge calculation from known rainfall in a watershed had been developed for tropical regions and the workshop provided opportunity to consider modifications incorporating snow and ice melt parameters. Similarly, the spreadsheet for waste load calculations could be modified to include known retention coefficients for the system.

An overview of historical and recent programs of nutrient research and budget development for the Black Sea was presented by Prof. Ilkay Salihoglu. The extensive data bases and the 5-year NATO-sponsored program were described, noting the availability of data in electronic form. The last whole-budget estimate for the Black Sea was developed in 1985, before the more recent field campaigns.

### Presentation of Site Biogeochemical Budgets

The preliminary biogeochemical budgets brought by the participants for regional sites were briefly presented and discussed. Key points included system settings, box arrays needed to encompass the sites, data availability and quality, and key features about the socio-economic settings and changes.

System sites included:

*Spain*
Palmones River estuary
Rio Pontia (NW Spain, Atlantic coast)

*France*
Gulf of Lions

*Morocco*
Sebou River estuary (Atlantic coast)
Nador Lagoon (Mediterranean coast)

*Italy*
Sacca di Goro Lagoon, northern Adriatic coast
Valli di Comacchio Lagoon, northern Adriatic coast
Venice Lagoon, Adriatic coast
S'Ena Arrubbia, Sardinia

*Greece*
NE Aegean Sea (west of Dardanelles)
NW Aegean Sea (Thermaikos Gulf and Sporades Basin)

*Turkey*
Bosphorus-Marmara Sea-Dardanelle Straits (Turkish strait system)

*Black Sea regions*
Dnieper Bay estuary
Sevastapol Bay system
Varna Bay (NW Black Sea)
Bourgas Bay (NW Black Sea)

[Additional budgets were developed by Inna Yurkova, Ukraine, who was awarded the LOICZ UNEP Regional Workshop Scholarship at the University of Stockholm working with Prof. Fred Wulff.]

**Biogeochemical Budgets Development**
Break-out groups worked interactively on the development of the coastal and regional seas systems, supplemented with methodological and site/issue tutorials and discussions. Estimates for sites and evolution of assessment approaches were made and budget refinements emerged from resolution of techniques, application of derivative data and assessment of estuarine mixing/exchange and watershed information.

A template for publication in the workshop report and for posting of site budgets to the LOICZ web-site were distributed and discussed.

**Regional Scaling and ELOISE Synthesis**
Dr Nicholas Murray provided an overview of the status of the EU ELOISE program, the role of the Joint Research Centre and a consideration of the ELOISE imperative for synthesis and integration of the ELOISE project results.

The ELOISE program is a European coastal zone cluster of research projects (a cluster or program addressing European Land Ocean Interactions), currently including active and completed projects funded by the European Community. The coastal zone cluster includes thematic issues:
- Ecosystem processes
- Physical coastal processes, and
- Integrated river basin or coastal zone demonstration sites.

Strands of activities address:
- Significant coastal seas in a global context,
- Human impacts on coastal seas,
- Socio-economic development associated with coastal seas, and
- Methodologies and implementation of ELOISE in support of policy.

The 30 continuing/completed and 18 new projects in 2001 have been run in a collaborative but relatively *ad hoc* family of activities, until the recent support provided to the Co-ordination Office.

A key policy area relevant to ELOISE is the European Watershed-Coastal Zone Integrated Study (EU Water Framework) aiming for clean water status in the EU by 2015, including inland waters and the coastal zone. Member states are to have implementation plans within six years and will depend on a synthesis of scientific information to underpin these plans; the lack of common methodologies makes comparison of approaches difficult. Development of effective and common methods for measurement and assessment could provide a vital plank.

The LOICZ comparative approach (using common methods) can contribute to this wider initiative in science. The first-order biogeochemical budget approach allows C-N-P comparisons between sites and could assist bench-marking throughout the EU region. Simple, robust approaches provide value for policy relationships; higher-order models and budgets based on an array of variables are often non-transportable between sites and, while vital for local scale management and options for development, do not allow wider regional comparisons. Similarly, the LOICZ typology approach contains a framework for data/process comparisons across scales, and could be applied along with other classification approaches.

The participants discussed various merits and concepts for regional comparison, particularly aimed at deriving scientific assessments linking science information (quality, quantity, visualisation) to the policy arena. A joint ELOISE-LOICZ Workshop was proposed, to develop very detailed CNP flux budgets for the whole of peninsular Italy, a data rich area, and to use the same format to develop a Mediterranean basin-wide estimate. ELOISE projects can provide input and good high resolution data for use to strengthen the link between CNP flux estimates and the LOICZ clustering methodology.

The workshop supported the suggestion that an expert working group should investigate the use of the combined biogeochemical-typology approach with results and information from the key ELOISE projects, and this would be most appropriately led and managed by the JRC Co-ordination Office. Further the workshop suggested that opportunity should be taken to further develop this action during the ELOISE Annual Meeting scheduled for September 2001; a topical workshop could be a useful way to proceed following wider discussion at the Meeting. It was recognised that this action could not lead to benefit for the EU initiatives, but would be of benefit to LOICZ in its global assessment of coastal changes in material fluxes, contributing from a rich data region to interpretation of net coastal system metabolism outcomes.

The LOICZ Typology and LOICZView tool was demonstrated by Dennis Swaney, and included:

- An overview of the approach and its purpose,
- Examples of initial applications and use of proxy variables, and
- A hands-on demonstration of constructing a typology to meet a specific objective or set of questions.

**Outcomes and Wrap-up**

Budgets for most identified systems were developed to interim draft stage of completion during the workshop; in some cases, partial budgets (e.g., salt and water) were prepared and additional data was to be included in finalised site budgets following the workshop. Text additions and checks on data sources were required for completion of most budgets manuscripts. A schedule for contribution of final documents, report and publication, along with the process for review and editing was agreed, noting that hard-copy reports, web-posting and CD-ROM products are planned.

Members of the Project steering committee met informally during the workshop to plan content and programs for further workshops, and to review and finalise arrangements for preparation and publication of tutorial and archival materials.

The participants joined with LOICZ in expressing thanks to Dr Christos Anagnostou and his organising team at the National Centre for Marine Research for the excellent support and hosting of the workshop in Athens. The financial support of the European Union and the Global Environment Facility was gratefully acknowledged.

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## Appendix III Workshop Agenda

**LOICZ/ELOISE/UNEP WORKSHOP ON ESTUARINE SYSTEMS OF THE MEDITERRANEAN AND BLACK SEA REGION**
**National Centre for Marine Research**
**Institute of Oceanography, Athens Greece**
**5-8 February 2001**

**Monday, 4 February**

0900 Welcome and announcements – Christos Anagnostou
Introduction of participants
0930 Introduction to LOICZ and IGBP – Chris Crossland
1000 Introduction to LOICZ budgeting approach and project overview – Fred Wulff
1030 Biogeochemical budgets calculation and web information – Vilma Dupra
1115 Typology and scaling in LOICZ – Dennis Swaney
1145 Outline of the LOICZ biogeochemical budgets web-site – Dennis Swaney
Discussion
1230 Lunch
1330 Tools: Presentation of CABARET budgeting software – Laura David
1400 Tools: Calculation of river discharge values – Laura David
1415 Tools: Calculation of waste loads – Laura David
1430 Participant presentation of sites and preliminary budgets
1700 Session close

**Tuesday, 6 February**

0900 Plenary discussion of continuing work plan and resource person collaborations.
0930 Break-out groups working on site budget preparation.
1230 Lunch
1330 Plenary discussion of status of work and problems
1345 Break-out groups resume work on budget derivation
1700 Plenary review of status of work for evening continuation

**Wednesday, 7 February**

0900 Break out groups continue
1115 Budgets presentations by participants
1230 Lunch
1330 Budget presentations continued
Identification of additional sites for budget estimates
1630 Synthesis and wrap-up session, and discussion of future activities of the group
1700 Budgeting workshop close

**Thursday, 8 February**

0900 Introduction to ELOISE – regional projects and needs for integration and regional synthesis, Nick Murray
0915 The LOICZ Typology and LOICZ – VIEW as tool for regional integration and upscaling - demonstration and discussion, Dennis Swaney
1100 Continued discussion: on integration of regional ELOISE biogeochemical project results
- ELOISE as a synthesising approach (comparability of results)
- The role of LOICZ in regional synthesis
- The role of typology

1200 Conclusions and final closure of the meeting

**Appendix IV Terms of Reference**

**LOICZ/ELOISE/UNEP Workshop on Estuarine Systems**
**Of The Mediterranean and Black Sea Region**
**National Centre for Marine Research**
**Institute of Oceanography**
**Athens Greece**
**5-8 February 2001**

**Primary Goal:**
To work with researchers dealing with estuarine systems of the Mediterranean and Black Sea region, in order to extract C,N,P budgetary information from as many systems as feasible from existing data, in order to build a comparative regional picture of material fluxes and processes. The Mediterranean and Black Sea systems include one of the major coastal regions of the world oceans and are heavily influenced by anthropogenic activity. The workshop provides an opportunity to characterize terrigenous inputs to the estuaries of the region, and outputs from the estuaries - hence the net role of the estuarine zone of this region as a source or sink for carbon, nitrogen, and phosphorus.

This workshop will complement, by the analysis of data from another important coastal region, earlier successful workshops:

a) LOICZ in Ensenada, Mexico, in June 1997, a second Mexican workshop in January 1999 (Merida, Mexico), and an Australasian workshop (Canberra, Australia) in October 1998; and
b) LOICZ-UNEP workshops on the South China Sea (Manila, Philippines) in July 1999, a South American workshop in November 1999 (Bahia Blanca, Argentina), a South Asia workshop in February 2000 (Goa, India), an East Asia workshop in Hong Kong in June 2000, and a Sub-Saharan Africa workshop in September 2000 (Zanzibar, Tanzania).

**Secondary Goal**
To integrate and exploit ELOISE and related research results for initiation of work to develop a first regional synthesis and upscaling of material flux and process information, with support from the LOICZ typology approach. This work will aim to provide an integrated regional picture of environmental change affecting coastal biogeochemical fluxes in southern Europe and place it into the broader context of global change in coastal zones. Here, the workshop is seen as a first step in the regional assessment process and it is expected that results and subsequent work will contribute to the pole-to-pole Europe-Africa typological assessment of material fluxes and their change, to be addressed at a thematic LOICZ-UNEP workshop in July 2001.

It is hoped that each workshop participant will be able to bring the available data for at least two estuarine/coastal sea site budgets: One from a "pollution hot spot" region within their country or ELOISE research focal point, and one for a physiographically fairly similar region which is apparently subjected to less pollution. By this strategy, we hope to compile a set of sites that will represent a relatively wide range of human pressures in the Mediterranean and Black Sea region.

**Anticipated Products:**
1. Develop budgets for as many systems as feasible during the workshop.
2. Examine other additional data, brought by the researchers, or provided in advance, to scope out how may additional systems can be budgeted over an additional 2 months.
3. Prepare a technical report and a CD-ROM summarizing this information, contributing to LOICZ/ELOISE/UNEP enterprise.
4. Contribution of these regional integrated site analyses to 1-2 papers to be published in the refereed scientific literature.

**Participation:**
The number of participants will be limited to fewer than 20 persons, to allow the active involvement of all participants. Nominees include:

- Up to 16 researchers from the region;
- Resource persons.

**Workplan:**
Participants will be expected to come prepared to participate in discussions on coastal nutrient budgets. Preparation should include reading the LOICZ Biogeochemical Modelling Guidelines (Gordon *et al.*, 1996), the Mexican Lagoons Workshop Report (Smith et al. 1997), examination of the budgets and tutorials presented on the LOICZ Modelling web page (http://data.ecology.su.se/MNODE/), and arriving with preliminary budgets, electronic maps, and preliminary 1-3 page write-ups from "their sites." In order to be included in the workshop report, the budgets should conform as best possible to the budgeting protocol laid out in the above documentation. Guidelines for budget preparation and write-ups and a tutorial package entitled CABARET can (and should) be downloaded from the LOICZ Modelling web site.

**Further Details:**
At an absolute minimum, each participant is expected to arrive at the workshop (or send us in advance) the following materials:

1. A 1-3 page description of the area (see materials posted on the Web and in the various workshop reports) and a map of the site. These should be in electronic format.
2. Within the context of needs for the overall project, some estimate of water exchange (most commonly via water and salt budgets) and budgets for the dissolved inorganic nutrients, nitrogen and phosphorus, constitute the minimum useful derivations from the biogeochemical budgeting. Budgets of other materials, while potentially interesting for other purposes, do not satisfy this minimum requirement. The minimum data requirements are as follows:
    a. The primary seasonal pattern of the region is at least one wet season and one dry season per annum. Ideally, a budget for each season would be developed. If a system is vertically stratified, then a 2-layer budget is preferred over a single-layer budget. If a system has a strong land-to-sea salinity gradient, then it is preferable to break the system into several boxes along its length.
    b. Data requirements to construct a satisfactory water and salt budget include: salinity of the system and the immediately adjacent ocean, runoff, rainfall, evaporation and (if likely to be important) inputs of other freshwater sources such as groundwater or sewage. Preferably, the salinity and freshwater inflow data are for the same time period (for example, freshwater inflow data for a month or so immediately prior to the period of salinity measurement). In the absence of direct runoff estimates for small catchments, estimations can be made from a knowledge of catchment area and monthly rainfall and air temperature for the catchment. See materials on the LOICZ biogeochemical modeling web site.
    c. Data requirements for the nutrient budgets are: concentrations of dissolved nutrients (phosphate, nitrate, ammonium and, if available, dissolved organic N and P) for the system and the adjacent ocean, concentrations of nutrients in in-flowing river water and (if important, in groundwater) some estimate of nutrient (or at least BOD) loading from sewage or other waste discharges. If atmospheric deposition (particularly of N) is likely to be important, an estimate of this is also useful. If direct waste load measurements are not available, estimations can be made from a knowledge of the activities contributing to the waste loads and the magnitudes of those activities. See the materials on the web-site.

**Background Documents:**
1. Gordon, D.C., Boudreau, P.R., Mann, K.H., Ong, J.-E., Silvert, W., Smith, S.V., Wattayakorn, G., Wulff, F. and Yanagi, T. 1996 LOICZ Biogeochemical Modelling Guidelines. *LOICZ Reports and Studies* **5**, 96 pages.

2. Smith, S.V., Ibarra-Obando, S., Boudreau, P.R. and Camacho-Ibar, V.F. 1997 Comparison of Carbon, Nitrogen and Phosphorus fluxes in Mexican coastal lagoons. *LOICZ Reports and Studies* **10**, 84 pages.
3. LOICZ Modelling web page, for everyone with www access: ( http://data.ecology.su.se/MNODE/ ).

- The LOICZ web pages, including the guidelines, are frequently updated. Recent additions to the site include several PowerPoint presentations designed to familiarize participants further with the budgeting procedures and with an overview of the LOICZ budgeting efforts.
- A CD-ROM with the current web page will be available during the workshop.
- CABARET (Computer Assisted Budget Analysis, Research, Education, and Training). A version of this software and a PowerPoint demonstration of its use are available on the web site and update version will be provided at the workshop.

## Appendix V Glossary of Abbreviations

| | |
|---|---|
| $NH_4$ | Ammonium |
| $NO_3$ | Nitrate |
| DIN | Dissolved inorganic nitrogen |
| DON | Dissolved organic nitrogen |
| DIP | Dissolved inorganic phosphorus |
| DOP | Dissolved organic phosphorus |
| PTN | Particulate total nitrogen |
| PTP | Particulate total phosphorus |
| POP | Particulate organic phosphorus |
| PON | Particulate organic nitrogen |
| ON | Organic nitrogen |
| OP | Organic phosphorus |
| TN | Total nitrogen |
| TP | Total phosphorus |
| DOC | Dissolved organic carbon |
| DIC | Dissolved inorganic carbon |
| POC | Particulate organic carbon |
| OC | Organic carbon |
| $SiO_4$ | Silicate |
| nfix | Nitrogen fixation |
| denit | Denitrification |
| p | Primary production |
| r | Respiration |
| TDN | Total dissolved nitrogen |
| TDP | Total dissolved phosphorus |
| CTD | Conductivity Temperature Depth |