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Land-Ocean Interactions in the Coastal Zone (LOICZ)

CORE PROJECT OF THE
INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME: A STUDY OF GLOBAL CHANGE
(IGBP)

LOICZ TYPOLOGY: Preliminary version for discussion

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1. Introduction

1.1 The global scope of LOICZ and the constraints of human and financial resources, necessitate the development of an objective typology of coastal units to serve as a sampling framework and to determine the appropriate weighting for preparing global syntheses, scenarios and models on the basis of limited spatial and temporal research data.

1.2 Financial and human resources to carry out LOICZ are finite and those available can be used more efficiently if they are focused in key geographic coastal regions. It is not necessary to conduct empirical studies in every coastal area of the world to develop global scenarios and models since large areas of the coastal zone have similar properties. One of the most important initial tasks for LOICZ is to establish a global coastal zone typology based upon available scientific information, both descriptive and dynamic. Such a system will group the World's coastal zone into several clusters of discrete, scientifically valid units based on both natural and socio-economic features and processes. Such a grouping is vital if the global syntheses which form a long-term goal of LOICZ are to adequately encompass the spatial and temporal heterogeneity of the World's coastal areas. Since not all areas can be sampled with the resources available, a rational approach to LOICZ studies must involve identifying the major categories of coastal units and ensuring that each grouping is adequately represented in the data sets used for preparing global syntheses. In addition the typology will be used as the basis for encouraging new research projects in coastal types that are under-represented in current research activities and for analysing and reporting results on a regional and global basis.

2. Objectives

2.1 Overall objectives

2.1.1 The overall objective of this framework activity is to categorise the World's coastal zone on the basis of both natural and socio-economic features, into a realistic number of geographic units, which will serve as a framework for:

- Overall co-ordination and planning of LOICZ research activities;
- Organisation of data bases;
- Selection of regions for extensive studies (remote sensing, long-term monitoring);
- Selection of appropriate sites for new local and regional coastal zone field and modelling studies;
- Scaling local to regional and regional to global models;
- Analysis, compilation and reporting of LOICZ results in the form of regional and global syntheses; and,
- Interfacing with the regional research nodes.

2.1.2 The result of this exercise will be a hierarchical system that will provide a basic framework for accessing and compiling local information that can be generalised at regional and global scales.

2.2 Specific Objectives

2.2.1 *Short-term*

- Develop a framework global coastal zone typology based upon existing scientific information; and,
- Use the typology to guide the development of the LOICZ Core Project.

2.2.2 *Long-term*

- Refine and develop the typology according to the evolving needs of the Project and the individual Foci; and,
- Apply the typology in preparing regional and global syntheses, and in developing scenarios and models

3. <u>The LOICZ typological approach</u>

3.1 This task was initiated early in 1995 and makes full use of recent advances in Geographic Information Systems (GIS) technology. The first step was to review existing coastal classification schemes and to decide the best approach to meet the LOICZ objectives.

3.2 While the priority areas for LOICZ research will be identified partly on the basis of initial results, this activity must be considered as on-going, dynamic and subject to evolution in terms of both methodology and output. The process of developing the typology will proceed on an iterative basis and the boundaries between different coastal units and the definition of representative types of coastal units will probably change as the project evolves and more data become available. The results of the typology exercise will be used to determine the organisation of LOICZ data bases and according to the specific requirements of each LOICZ Focus. For example, the typology will provide the basis for selection of specific coastal zone units in which empirical and modelling studies of carbon flows are needed to ensure global coverage of the variability displayed by the World's coastal subsystem. Without a rational framework for grouping the World's coastal zones, the appropriate weighting for data from each coastal type cannot be determined and accurate global syntheses of the role of coastal sub-system in the Earth system cannot be prepared.

3.3 The primary goal of LOICZ activities is to develop global syntheses of, for example, the role of the coastal ocean as a source or sink for organic carbon. All LOICZ activities will address the need to arrive at such global estimates. These estimates will be constructed at two general geographic scales that will be explicitly identified in the LOICZ typology: local and regional. Information and data collected at these scales will be used to refine existing global estimates and to generate new estimates of the role of coastal areas in global processes. In the short term global estimates of the extent, and rates of change, in coastal habitat types should be possible. In the longer term global estimates of the rates of change in biogeomorphological and socio-economic processes in the coastal zone should also be possible.

3.4 The local geographic scale is the one most commonly addressed by current scientific research, and generally involves site-specific studies in a particular watershed, estuary, bay or stretch of coastline. Such research provides very detailed, specific information for a limited geographic area, and tends to generate precise, accurate information that is best understood by local investigators. Information at this scale, will form the basis of LOICZ empirical research and studies. At this level efforts will be made to arrive at estimates of total coastal area and the proportion of the area identifiable by habitat type such as intertidal, marsh, coral reef, mangrove swamps, etc. Building on the local expertise it should be possible to arrive at accurate estimates for these variables. Efforts will be required to access this information and combine it with similar information for other areas to generalise upwards to the regional and global level.

3.5 The regional geographic scale will form the basic unit of the LOICZ typology. It will cover wider geographic areas associated with coastal units that will include estuaries, watershed areas and continental shelf areas for identifiable sections of the World’s coastal zones. Although some research is carried out at this geographic scale much of the information for this scale will have to be generalised from the more detailed local studies. Using the typology it should be possible to generalise the detailed data to the larger, regional geographic scale and also to extrapolate from well studied areas to those of similar properties that are not as well studied.

3.6 The general approach to this task involves five steps: initial identification of regional level units; data selection and compilation; statistical analysis for similarity; review and revision; and review and update.

i) The initial identification of regional level units has been carried out by the LOICZ Core Project Office (CPO) with input from the LOICZ Scientific Steering Committee (SSC). An initial division of the World’s coastal zone into regional units has been generated based on a limited set of general geographic characteristics. In an effort to promote discussion and input from the network of LOICZ corresponding scientists, a map of the regions has been produced here for comment and critical review (Figure 1).

ii) Concurrent with the circulation and review of the initial typology, the CPO is proceeding to select, acquire and compile global databases on which to improve and revise the typology.

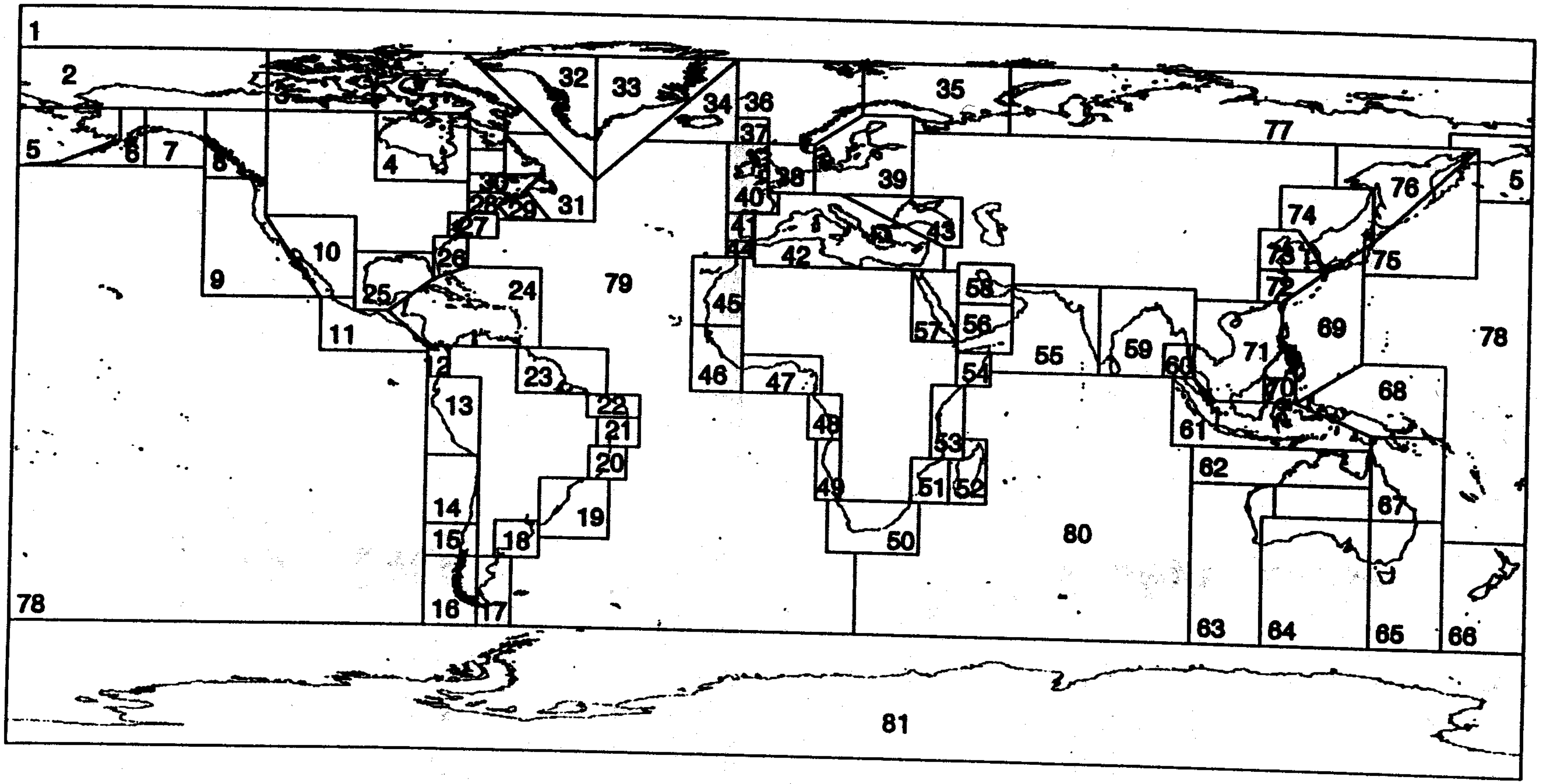

Figure 1. LOICZ Regional Division - Draft -
actual boundaries will be determined by elevation and bathymetric contours

iii) An initial statistical analysis has been carried out as an example of a possible methodology for identifing similarities among and differences between the defined areas. The results of this analysis are presented here for comments and review. Following comments from the LOICZ Research Network, and the results of step ii) additional analyses will be carried out. In time these analyses will allow useful aggregation of areas into groupings with similar biological, physical, chemical and socio-economic properties.

iv) The review and revision of the LOICZ typology is seen as a critical step in that it will allow experts in each area to apply their local knowledge to issues such as the homogeneity, or otherwise of the regional units, and the nature and coverage of the required data sets, their suitability and relevance. This iterative revision process will continue throughout the life of the project. This document provides the first opportunity for broad discussion, exchange and input on the structure and further development of the typology for use in the LOICZ Project. Following a reasonable period for review and comment, the CPO will publish the results of the discussions as the 1st version typology, towards the end of 1995.

v) It is expected that during the ten years of LOICZ research, comments will be received based on on-going LOICZ research concerning the applicability and usefulness of the established typology. At appropriate points in time, the CPO will update the typology and publish revised versions throughout the lifetime of the LOICZ project. The typology will evolve from this initial draft for use in organising research efforts to provide in later years a framework for production of global syntheses.

4. Review of previous coastal classification schemes

4.1 There exist many different coastal classification systems devised for different purposes and covering various sections of the World’s coastline. LOICZ will attempt to build on these existing approaches to generate a broadly based typology for the World’s coastal areas.

4.2 In general there are two main types of data used in classifying coastal areas:

- detailed analyses of restricted areas based on selected local variables such as substrate type, habitat and wave climate (Anon, in press; Anon, 1992a); and
- global approaches based on one or two types of data such as the distribution of ecosystem types (Wilkinson and Buddemeier, 1994; UNEP, 1994) or geomorphology (Jelgersma *et al*., 1993). The LOICZ typology will attempt to incorporate both types of data.

4.3 There exist two basic approaches to the process of classification, the first of which is based on the recognition of differences, the second on similarity. The first approach relies on the identification of key variables separating the units to be classified, and in the case of coastlines for example, might include an initial division into eroding and accreting shorelines. Such an approach often results in a heterogeneous category of dissimilar units somewhere within the classification hierarchy, and essentially serves only to distinguish individual coastal units one from the other. Such a scheme is used in biological keys for the identification of particular organisms and is termed an “artificial classification”. The second approach, based on similarity, groups the units to be classified according to shared characteristics and gives rise to groups within the hierarchy that display varying degrees of similarity. This approach is the one used in modern biological classification and the methods of numerical taxonomy can be applied to the problems of classifying coastal environments. Such an approach has been under utilised in classical attempts at classifying coastal environments and should allow LOICZ to identify regions of varying degrees of similarity, permitting the use of empirical data from one region as analogue data for other similar regions in the preparation of global syntheses.

4.4 Two examples of the application of the tools of numerical taxonomy to the classification of shorelines are the work of Jelgersma *et al*. (1993) and Kuroda and Nanaura (1993). These papers also provide examples of a global classification that include a number of different types of variables such as wave climate, tidal characteristics, morphology and population density. In both cases the authors established defined areas, collated the data and then carried out the classification. Given the quantity and quality of global data presently available for LOICZ, this type of approach seemed appropriate for preparing the first draft typology.

4.5 Through the review process outlined in Section 3, experts from each region will be encouraged to provide guidance on existing local and regional classification schemes and the appropriate way in which the LOICZ typology can be harmonised with existing data and approaches, into a truly global typology.

5. Major issues in developing the LOICZ typology

5.1 Definition of spatial boundaries for units in the LOICZ typology

5.1.1 As part of the typology exercise, it will be necessary to define landward and seaward boundaries to define the area of study for LOICZ. For the purpose of LOICZ research the ocean boundary is taken as the continental shelf edge, delinated by the 200 m isobath. The landward boundary is more difficult to establish and is likely to vary from region to region. Pernetta and Elder (1992) discuss the difficulties of establishing a landward boundary for the World's coastal zones and note that processes and activities occurring at considerable distance inland from the shore may have major impacts on the scale and direction of processes occurring in coastal environments. They cite as examples, shoreline recession and erosion in the Mississippi and Nile deltas as a consequence of inland dam construction and water flow regulation changing the sediment nutrient and freshwater budget of the deltas. To extend the definition of the coastal zone to the upper limits of the catchment basin or watershed is unrealistic within the framework of a single system or programme. Thus it is necessary to define the primary area of interest of LOICZ in a more restricted manner with the landward boundary occuring in closer proximity to the land-water interface.

5.1.2 It is important to recognise that within the coastal zone the landward boundaries between the fresh and saline water systems do not correspond to the boundaries between the ocean influence and land. In the case of the aquatic environment the limit of penetration of saline water influence in estuaries extends further inland than the penetration of extreme high tides on land, but rarely corresponds to the landward limit of marine influence in terms of atmospheric transfer of salts inland. The penetration of saline water influence in the aquatic environment is less than the extent of inland penetration of tidal energy in the form of tidal bores for example. Hence the inland limits of the coastal zone may be quite different in the context of the aquatic environment from those identified in the terrestrial environment.

5.1.3 Four definitions of the landward boundary are being considered:

i) Use of a land based system comparable to the marine 200 m isobath, the 200 m elevation could be used. This definition gives rise to large variations in the relative amount of terrestrial land mass to be studied in the different areas. In some regions of the world, there are extensive terrestrial coastal areas at very low elevation while in other regions mountains rise steeply in close proximity to the shore, resulting in very narrow bands of low-lying land close to the ocean. In itself this is not a reason for abandoning such a boundary since similar considerations apply in terms of the width of the continental shelf.

ii) Defining the inland boundary at a specified distance inland from the high tide mark. This method is often the basis for coastal zone management regimes but is too arbitrary and may exclude areas that are of interest to LOICZ, or include areas external to the coastal zone.

iii) A third alternative definition of the landward boundary for LOICZ could be developed on the bases of the major break in slope. Although such a definition may be more difficult to identify, it may give a better estimate of the coastal land mass that directly influences, and is itself influenced by, the coastal ocean.

iv) The limits of saline water intrusion into estuarine areas may be taken as another definition. Such inland limits may or may not correspond in particular areas to the limits of consequence of tsunami or storm surges and may not reflect the inland limit at which impacts resulting from changes on the coast may be felt. Nevertheless, swamp forests backing mangroves on tropical coastlines or salt marshes elsewhere for example, are particularly sensitive to small changes in saline water intrusion.

5.1.4 Due to the presently limited availability of an electronic database in the CPO for defining elevation and bathymetry, a detailed analysis of this issue is not possible at this time. The acquisition of such data in the near future will enable LOICZ to carry out this analysis in the next version of the typology.

5.1.5 In this initial discussion document regions are identified as rough "boxes" within which LOICZ will be interested in the processes and dynamics of change occuring within the area between 200 m above and below present mean sea level. Within the identified LOICZ regions (outlined in Figure 1) much of the area will be too far off shore or too far inland to be of direct interest to LOICZ. Research in these areas will be carried out by other IGBP Core Projects such as the Land Use and Cover Change (LUCC) or Biospheric Aspects of the Hydrological Cycle (BAHC) Core Projects, or by coordinated research among two or more IGBP Core Projects (JGOFS/LOICZ, 1994). A certain amount of LOICZ research will be required to understand the interactions across the landward and seaward boundaries.

5.2 Selection of variables

5.2.1 There are many variables that could be used to generate a coastal typology and an important consideration in the selection of variables is the need for worldwide data coverage. Although high quality data are available for some limited areas, such data are not applicable for the initial task of dividing the World's coastal zones into major regional units. Although there are difficulties in using data of varying quality from different areas of the world, the need for global coverage overrides such concerns. Over the lifetime of LOICZ, it is expected that variance in data quality will be reduced as LOICZ research is carried out. New and more accurate data over larger geographic areas will be included as it becomes available and will be incorporated during the review and revision of the typology.

5.2.2 For the initial development of the LOICZ typology a series of general qualitative variables have been estimated (see Annex 1). Of these only six of these variables have been estimated for all regions:

i) freshwater runoff (Ludwig *et al.* , in press);
ii) shelf width from general maps of the world;
iii) tidal range based on assorted data sources;
iv) phytoplankton concentration based on interpretated coastal zone colour scanner images (CZC);
v) June sea surface temperature from Seawifs Mosaic Internet home page; and
vi) December sea surface temperature from Seawifs Mosaic Internet home page.

5.2.3 Qualitative class values for each of these six variables has been assigned to all regions as detailed in Appendix 1. The purpose of these test data is to demonstrate the application of statistical methods to a cluster analysis of the initial regional divisions selected for use in this typology.

5.2.4 At present there are several additional variables supported by existing electronic databases that are being considered by the CPO for inclusion in the next version:

- coastal topography from the Digital Chart of the World (Defense Mapping Agency);
- coastal bathymetry from GEBCO Bathymetry (International Oceanographic Commision;
- chlorophyll concentration Coastal Zone Colour Scanner (SeaWifs - Feldman *et al.* , 1989);
- catchment area and river runoff GLORI database (GEMS/LOICZ);
- coastal physical oceanography CPO/SSC;
- socio-economic variables World Data Base (Anon., 1992b);

With these databases it is anticipated that a more rigorous statistical analysis than that illustrated here, can be undertaken. Additional databases on global geomorphology, land use, shoreline uplift or subsidence, sedimentation rates etc. will also be used, as they are acquired. One of the major limitations of the present application of the approach taken in this document is the lack of socio-economic information that will be required for LOICZ Focus 4 activities (Pernetta and Milliman, 1995). The identification of additional data required for the typology will be carried out in conjunction with the development of the LOICZ Data System Plan.

5.2.5 One of the early steps in developing the typology will be to compile a listing of variables that need to be taken into consideration for detailed examination of areas and their boundaries. It should be noted that the variables used in this initial analysis relate mainly to the coastal ocean, hence the groupings identified in the cluster analysis reflect similarities based largely on oceanic conditions and not on the terrestrial and socio-economic environments.

5.3 Representation of boundaries

There exist several ways of representing the spatial boundaries of geographical areas. Each methodology has strengths and weakness for use in LOICZ.

i) lines can be drawn perpendicular to the shoreline delineating the boundaries. The strength of this system is that is draws attention to the actual shoreline. The weakness is that it really does not represent the 2- and 3-dimensional nature of the coastal zone that includes both aquatic and terrestrial areas.

ii) complex smooth curves such as those used within the Large Marine Ecosystem Programme (Sherman, 1994). The strength of this system is that it can accurately represent the areas by following the isobaths and land features. The difficulty with this representation is that the actual line drawn on a 2-dimensional map will depend on the projection variables of that particular map. Although this is easily handled by the GIS, in cases were hard copy maps are to be used, it is a difficult process to accurately represent the boundaries.

iii) straight line polygons, having boundary lines of latitude and longitude, with accurately defined corner points. The seaward boundary and landward boundaries would be made explicit within each box depending on an accepted LOICZ definition (see Section 5.1). The main limitation of this system is that it does not follow the actual physical boundaries of a coastal zone such as bathymetry or topography. An additional concern is that if squares are used to represent large areas, much of the area enclosed in the defined area will be open ocean or inland areas. The strength of this method is that it provides the most accurate way for scientists to plot the areas on a hardcopy map, so long as latitude and longitude are displayed. This is a significant advantage for many hard copy images and applications that will be used where a GIS is unavailable or inappropriate and where applications will have to use hard copy maps. Whereas every effort should be made to have boundary lines running north/south or east/west, in areas where this is not appropriate, it would be necessary to define both the end points and the map projection for accurate plotting.

5.3.1 Based on the need to use this typology globally with a variety of electronic and hard copy products, it is recommended that the third method of representing boundaries is probably the most useful. This is the method used here for the intial development of the typology described in the remainder of this document.

6. Regional divisions used in the cluster analysis

6.1 Figure 1 shows the regional units identified as described in the first step in section 3.6. The Large Marine Ecosystem (LME) divisions of the coastal ocean (Sherman, 1994) were taken as a basic starting framework. Sherman (1994) identifies 49 Large Marine Ecosystems in the coastal ocean, on the basis based on a variety of considerations including stress on biological populations, topography and bathymetry, EEZ limits and physical oceanography. Although the LME approach is primarily directed toward the management of living marine resources and in particular the major fisheries of the world, it provides a useful initial classification for testing the LOICZ approach.

6.2 The second step makes use of general information concerning physical, chemical, biological and human variables. Thirty additional coastal regions were added to the 49 LME's and together with three oceanic regions (Pacific, Indian and Atlantic Oceans) all the World's coastal zones are included in the 81 regional units used in the first analysis (Figure 1). Table 1 lists the regions by number and name while Appendix 1 provides a listing for each region of the latitudinal and longitudinal co-ordinates of the corner points and the basic data used in this analysis.

6.3 As discussed in section 5.3, attempts were made to define all regions by lines following latitude and longitude so that regional maps can be easily generated on hard copy base maps of different projection using the co-ordinates for the corner points. In some cases this was not possible, for example, regions 32 and 33 for Greenland. In these instances, straight lines connecting corner points drawn on maps with projections other than the geographic projection used here will not accurately define the regions.

6.4 In two cases a single LOICZ region is presented as two distinct areas, (region 5, the Bering Sea; region 78, the Pacific) in Figure 1, although in the cluster analysis they are treated as a single unit.

Table 1. List of LOICZ Regions by number and name

Number	Name of the Regional Area	Number	Name of the Regional Area
1	Arctic Ocean	42	Mediterranean Coast
2	Beaufort Sea	43	Black Sea
3	Canadian Archipelago	44	Morocco Coast
4	Hudson Bay	45	Sahara-Mauritania Coast
5	Bering Sea	46	Drowned Coast
6	Aleutian	47	Gulf of Guinea
7	Alaska Coast	48	Congo Basin
8	West Coast of Canada	49	Namibia-Angola Coast
9	West Coast of United States	50	South African Coast
10	Gulf of California	51	Zambezi-Limpopo
11	West Central American Coast	52	Madagascar
12	Colombia Coast	53	Tanzania-Kenya Coast
13	Ecuador-Peru Coast	54	Somali Coast
14	North Chile Coast	55	Arabian Sea
15	Central Chile Coast	56	Gulf of Aden
16	South Chile Coast	57	Red Sea
17	South Argentine Coast	58	Persian Gulf
18	Central Argentine Coast	59	Bay of Bengal
19	South Brazilian Bay	60	Adaman Sea
20	Abrolhos-Campos Coast	61	Indonesia
21	East Coast of Brazil	62	Northern Australian Shelf
22	North East Brazil Coast	63	West Coast of Australia
23	Amazon Shelf	64	Great Australian Bight
24	Caribbean	65	South East Coast of Australia
25	Gulf of Mexico	66	New Zealand Shelf
26	South-Atlantic Bight	67	Coral Sea
27	Mid-Atlantic Bight	68	Micronesia-Papua New Guinea
28	Gulf of Maine	69	Philippines Sea
29	Scotian Shelf	70	Sulu-Celebes Seas
30	Gulf of St. Lawrence	71	South China Sea
31	Newfoundland Shelf	72	East China Sea
32	West Greenland Coast	73	Yellow Sea
33	East Greenland Coast	74	Sea of Japan
34	Iceland Coast	75	Oyashio Current
35	Barents Sea	76	Sea of Okhotsk
36	Norwegian Coast	77	Kara-Laptev-Siberian Sea
37	Faroë Plateau	78	Pacific Ocean
38	North Sea	79	Atlantic Ocean
39	Baltic Sea	80	Indian Ocean
40	Celtic-Biscay Coast	81	Antarctic
41	Iberian Coast		

7. <u>Preliminary cluster analysis</u>

7.1 Data for the six test variables described in section 5.2.2 for all regions were used in a trial cluster analysis to examine similarities between regions. Systat for Windows (version 5.04) was used to carry out average-weighted eigenvalue cluster analysis (see Jelgersma *et al.,* 1993; Kuroda and Nanaura, 1993). The analysis suggests that the 81 initial regional units can be grouped in 5 major clusters. The results are presented in the dendrograms in Figures 2-7. Figures 2-6 present clusters of the most closely related regional units whilst Figure 7 provides an overview of the relationships between the seven groups illustrated in Figures 2-6 inclusive.

7.2 Figures 2-6 illustrate the relative distance between LOICZ regions based on their similarity with respect to the six input variables. The degree of difference between regions is represented by the length of the line extending from the region name to its point of junction with a neighbouring line. The shorter the line the more similar the region is to its nearest neighbour, for example, the Central and South Argentine regions have identical eigenvalues suggesting that for the purposes of the test variables they should be combined into a single unit. Similarly the West Coast of Canada, Aleutian, Alaskan and South Chile units have identical values and whilst the Canadian West Coast, Aleutian and Alaskan units are geographically contiguous and might be combined in a subsequent analyses, the South Chile region could not be combined with the other three. For purposes of future syntheses however, data from any one of these regions might be used as analogue data for the others in the event that empirical data are not available for all units.

7.3 Areas in close geographic proximity such as the Central and South Argentina regions in group 1 tend to be more closely linked, reflecting in part the highly restricted type of input data and possibly also real similarity in respect of the input variables. In many of these cases the regions are likely to be distinguished when more quantitative data and a wider range of variables are used. It is interesting to note that some regions separated by large geographic distances are identified as closely similar with respect to present data set. One such example is the similarity of the Newfoundland and North Sea regions in Group 6. This type of result demonstrates the usefulness of this approach to LOICZ data management and the analyses that will be required to generate global estimates of coastal processes.

7.4 It should be noted that group one (Figure 2) consisting of 13 regional units forms the most distinct cluster, separated from the remaining 68 regions by the largest euclidean distance, of these the East China Sea region represents an outlier to the rest of the group. The 21 regions included in Figure 4 fall into two distinct groups of which group 3 shows greatest similarity to group 2. The Red Sea, Persian Gulf and Mediterranean regions form a distinct cluster with greater similarity to the combined cluster of groups 2 and 3 than with any other group. Group 6 (Figure 6) contains two outliers with the Black and Baltic Seas form one outlying cluster and the Antarctic showing slightly greater similarity to this combined grouping than to group 5. the Kara, Laptev and Siberian Seas and the Arctic Ocean, identified as group 7 in Figure 6 form a distinct outlying group with marginally greater similarity to groups 5 and 6 than to groups 2, 3 and 4. This anomalous result probably reflects the absence of Coastal Zone Colour Scanner data for these regions.

7.5 Finally Figure 7 provides an diagrammatic overview of the relationships between the groups identified in Figures 2 - 6 and includes a qualitative description of the major characteristics of each of the groups or clusters with respect to the input variables.

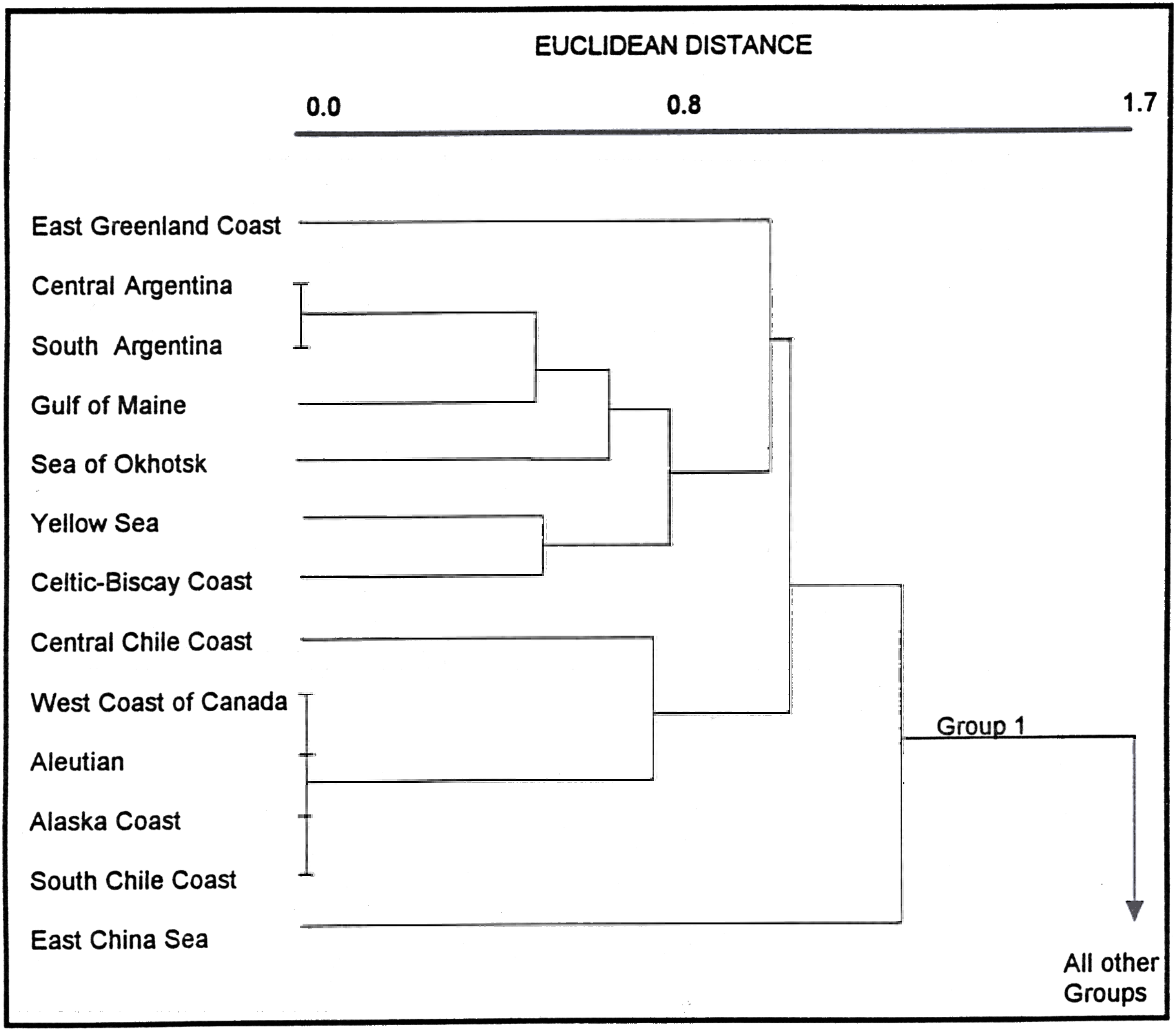

Figure 2. Average weighted eigenvalue cluster analysis of LOICZ regions in Group 1.

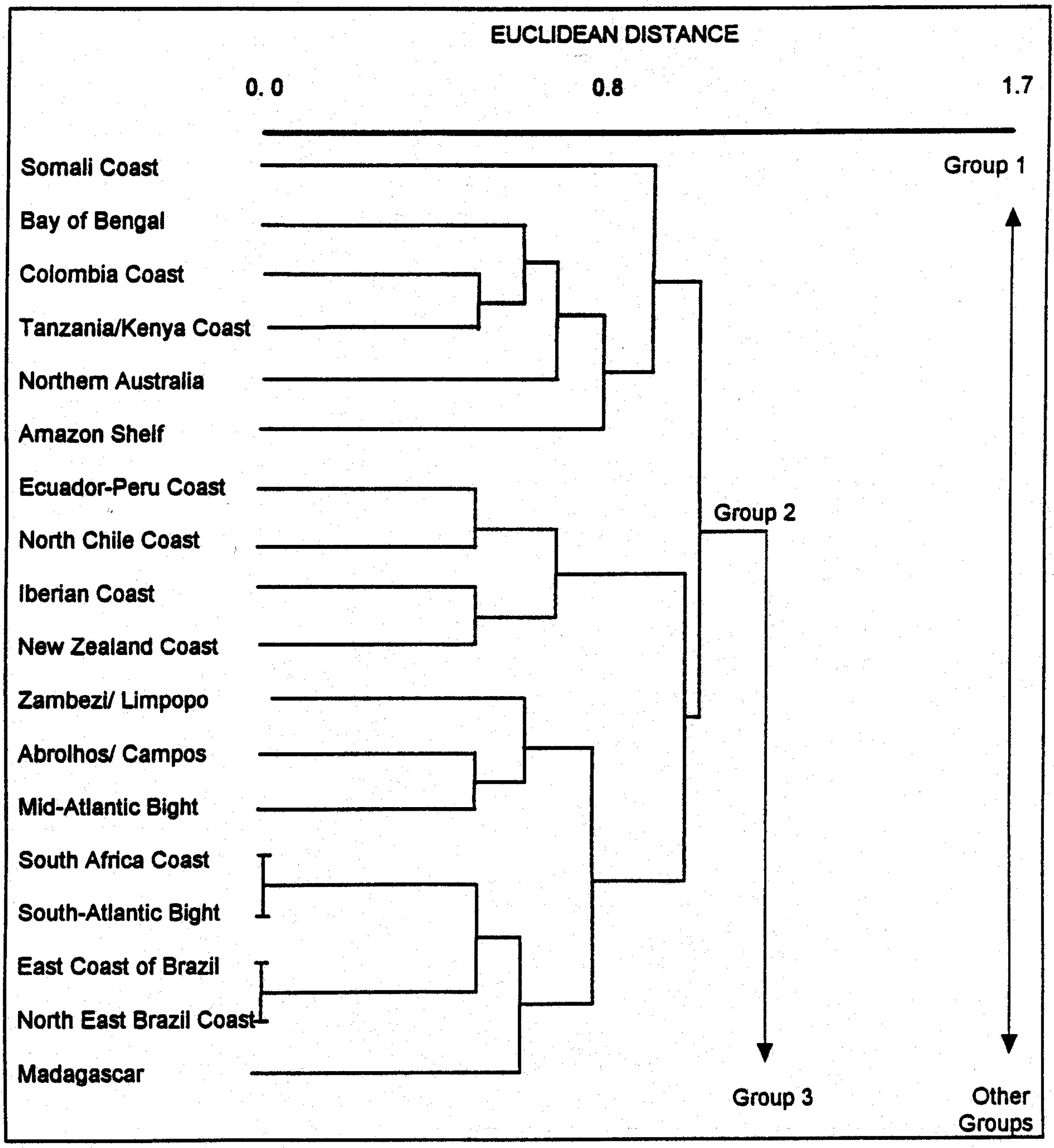

Figure 3. Average weighted eigenvalue cluster analysis of LOICZ regions in Group 2.

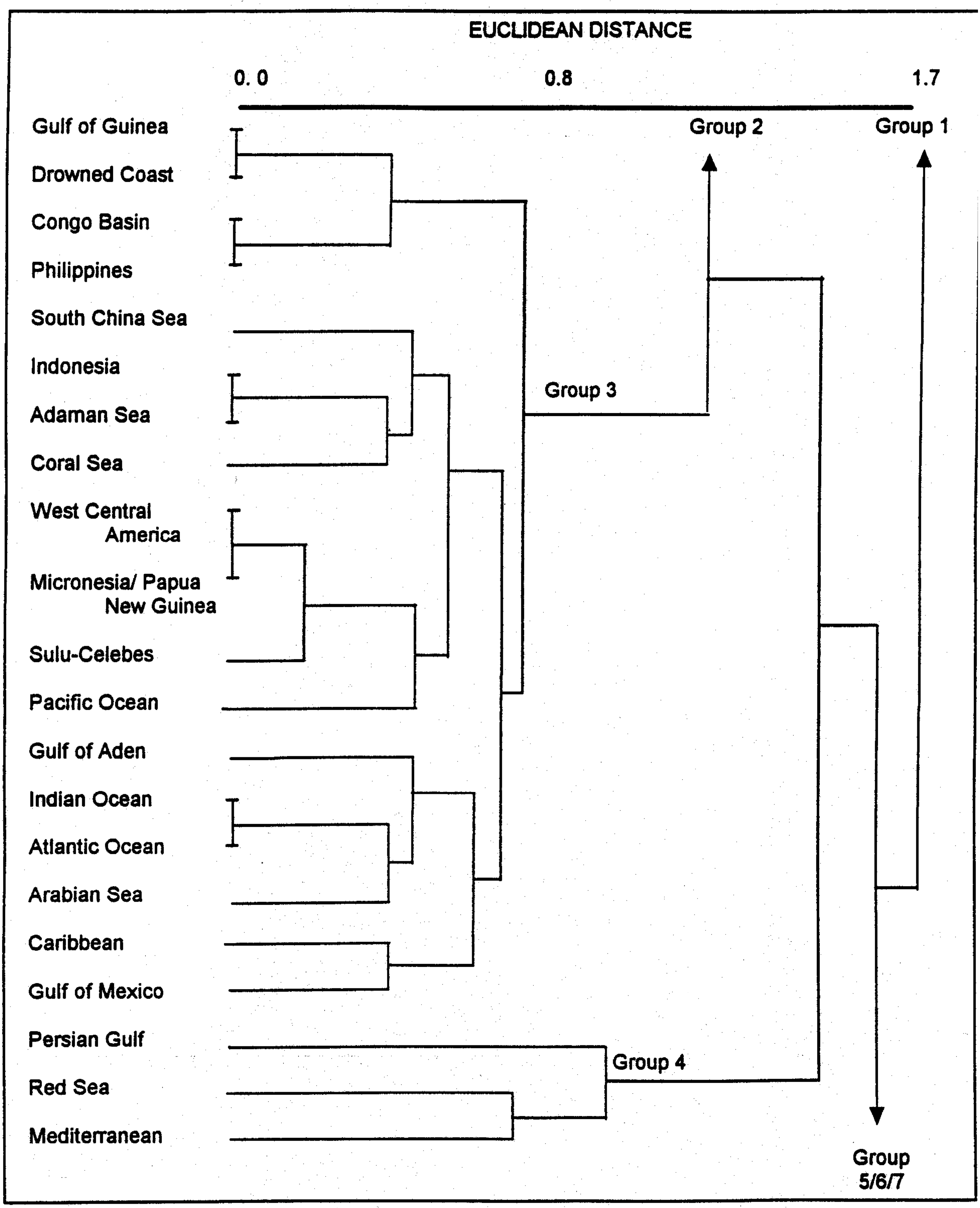

Figure 4. Average weighted eigenvalue cluster analysis of LOICZ regions in Groups 3 and 4.

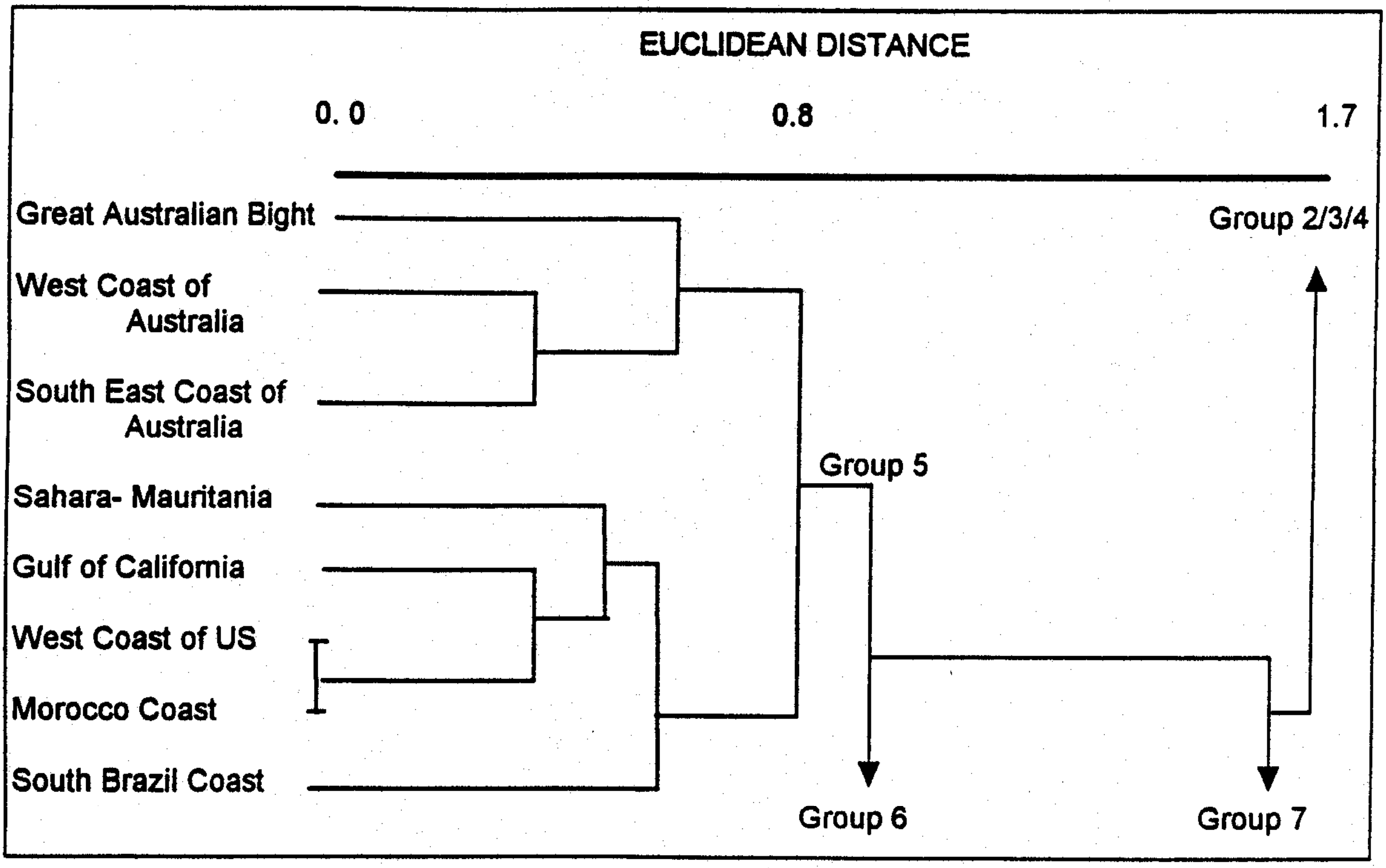

Figure 5. Average weighted eigenvalue cluster analysis of LOICZ regions in Group 5.

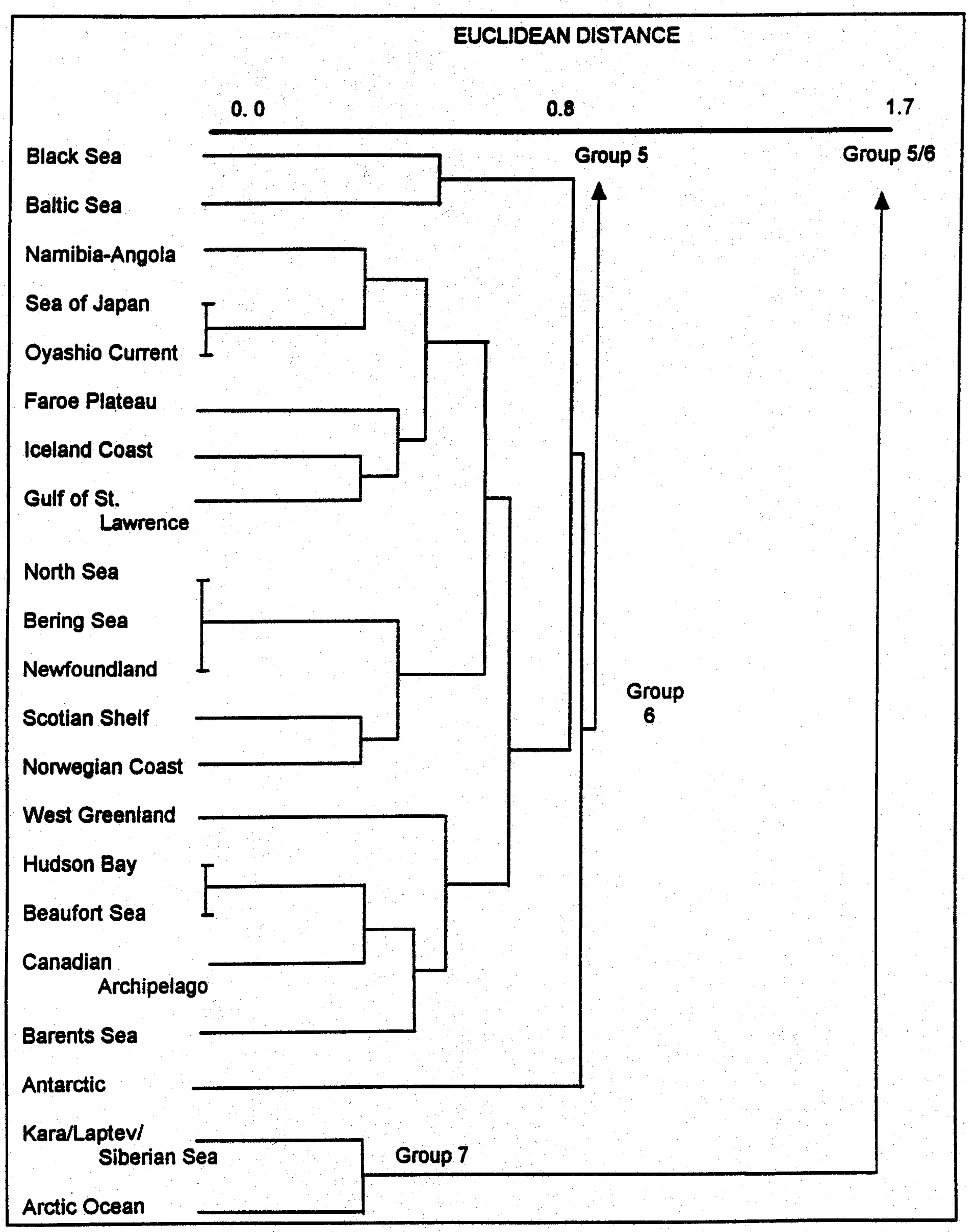

Figure 6. Average weighted eigenvalue cluster analysis of LOICZ regions in Groups 6 and 7.

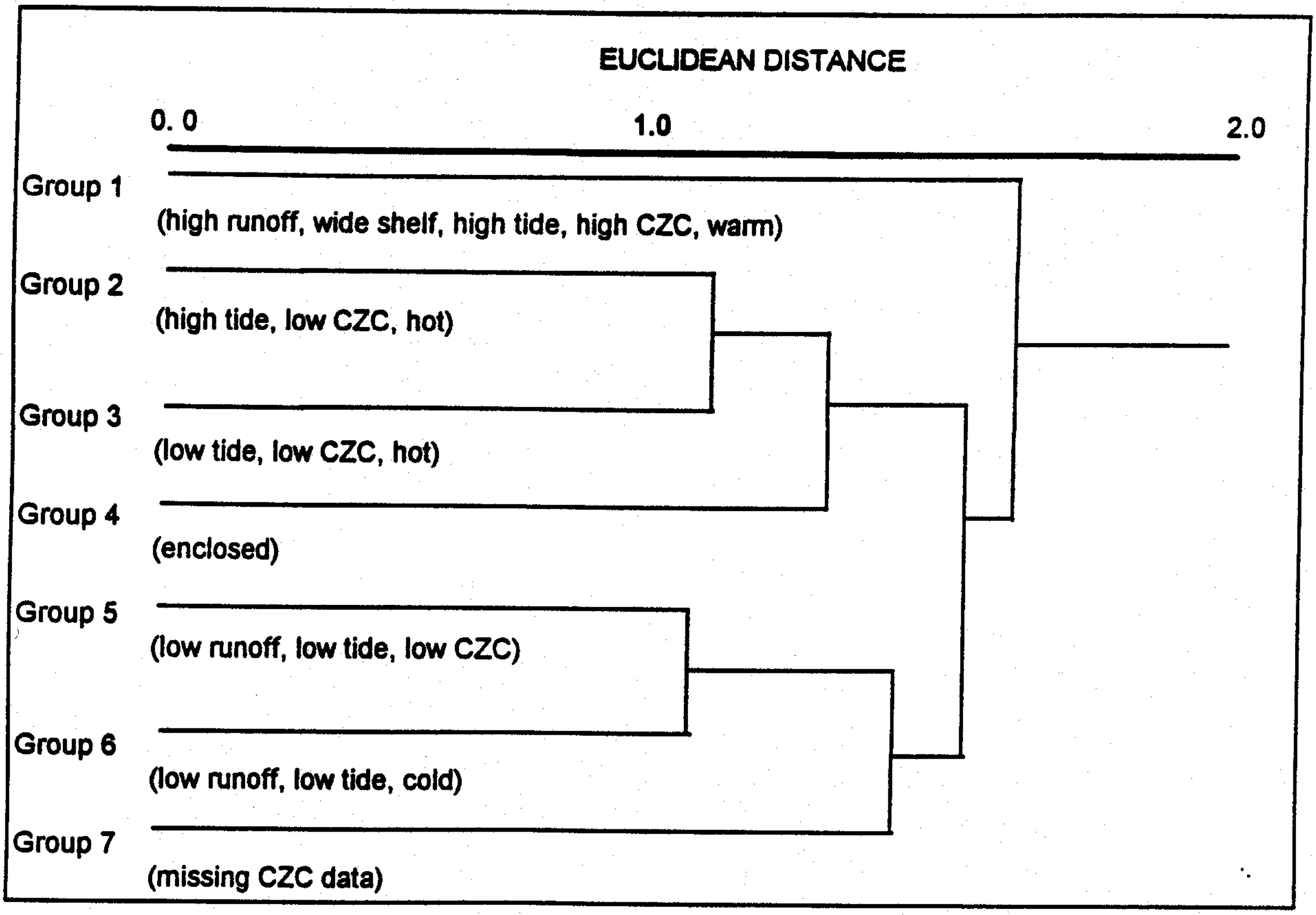

Figure 7. Average weighted eigenvalue cluster analysis of all seven groups.

8 Conclusions

8.1 In all cases the usefulness of these results are dependent on the limited amount of semi-quantitative data that were used in the analysis. The purpose of this test was only to investigate the technique as a method for generating measures of similarity and dissimilarity among the regions. The conclusion is that with sufficient data, the technique does provide a useful means of grouping regions.

8.2 It should be pointed out that the present analysis does not provide any indication of why the regions are similar or dissimilar from a statistical perspective. The reasons for the degree of similarity can be determined using a discriminate function analysis which identifies the comparative weight given to each variable in the cluster analysis. Such statistical analyses do not however identify the causal relationships which give rise to the statistical relationships, hence the interpretation of the validity of the relationships identified will depend on an understanding of the underlying processes. Understanding the underlying relationships is essential before LOICZ can proceed to use research results from one region as analogue data for another. As noted above the Canadian West Coast, Aleutian and Alaskan regions and the South Chile Coast are revealed in the present analysis as being of very similar characteristics. The analysis does not distinguish whether they are similar because of the large range of sea surface temperature from summer to winter or whether they all have similar levels of phytoplankton density as interpreted from the Coastal Zone Colour Scanner image or whether both these characteristics are important. Additional analyses, such as principal component analysis, and discriminate function analysis are essential to answer these questions (see Gabriel *et al*. 1982; Krzanowski, 1988; and Seber, 1984). The next iteration of the typology will include some of these necessary analyses.

8.3 As the quantity and quality of available data increase, separate analyses of the type presented here could be carried out, based on the major variables of importance for each of the four LOICZ Foci. This will allow similarities to be identified within foci independently of the constraints of the other focus. That is, areas that are similar on the basis of biogeomorpology may not have any similarities on the basis of their socio-economic characteristics. A full multivariate analysis based on all parameters for all four foci will be needed for the preparation of global syntheses and will be of considerable value in identifying the likely driving forces of coastal change at regional and global scales.

9. Continued development of the LOICZ typology

9.1 The LOICZ CPO would like to encourage the scientific review of the ideas and concepts described in this document. Concurrently with the on-going compilation of additional data and information on which to further develop the typology the LOICZ Research Network is therefore invited to provide review and comment.

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APPENDIX I

LOICZ Regional Descriptions

This appendix provides a tabular description of each of the LOICZ regions defined in this draft typology. Each region is identified by a name, a number, and a list of co-ordinates that define the region in a geographic reference system. Negative values are to the west of 0^o Longitude or south of 0^o latitude. Each region can be created on a map by connecting the nodes with lines running along lines of latitude and longitude. Attempts have been made define all regions with lines running north/south or east/west. Where this is not possible, the nodes should be connected using a geographic reference system consisting of latitude and longitude.

The values in this table are general qualitative data for the region conditions. With time these estimates will be made more quantitative and many more variables will be added.

The following variables are those used in the cluster analysis presented here:

Runoff (Ludwig *et al.*, in press):	low = 1; medium = 2; high = 3.
Tidal range in cm (LOICZ CPO/SSC):	1 = 0-25; 2 = 25-50; 3 = 50-75; 4 = 75-100; 5 = > 100.
Shelf width (LOICZ CPO/SSC):	enclosed = 1; narrow = 2; and wide = 3.
June SST (June sea surface temperature from SeaWIFS Mosaic Home Page interpreted by CPO (Feldman *et al.*, 1989))	cold = 1; cool = 2; warm = 3; hot = 4.
Dec SST (December sea surface temperature from SeaWIFS Mosaic Home Page interpreted by CPO)	cold = 1; cool = 2; warm = 3; hot = 4.
CZC (Coastal Zone Colour Scanner SeaWIFS Home Page)	low = 1; medium = 2; high = 3.

The listing below provides examples of some of the variables currently being examined for future inclusion.

Major habitats:	e.g. mangrove, mangrove/coral, mangrove/salt marsh, salt marsh.
Sediment Flux (LOICZ CPO/SSC):	small = 1; moderate = 2; large = 3.
Boundary current strength (LOICZ CPO/SSC):	weak = 1; strong = 2.
Marginal Sea (LOICZ CPO/SSC):	shallow = 1; deep = 2.
Upwelling Strength (LOICZ CPO/SSC):	weak = 1; strong = 3.
Ice Cover (LOICZ CPO/SSC):	never = 1; in winter = 2; always = 3.

LOICZ Name: **Arctic Ocean** LOICZ No: **1**

Corner Points:		Variables:	
Latitude	Longitude		
80	-180	Runoff:	1
90	-180	Tide:	1
90	180	Shelf width:	3
80	180	June SST:	2
		Dec. SST:	1
		CZC:	0
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	3

LOICZ Name: **Beaufort Sea** LOICZ No: **2**

Corner Points:		Variables:	
Latitude	Longitude		
65.5	-180	Runoff:	2
80	-180	Tide:	1
80	-121.5	Shelf width:	3
65.5	-121.5	June SST:	2
		Dec. SST:	1
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	3

LOICZ Name: **Canadian Archipelago** LOICZ No: **3**

Corner Points:		Variables:	
Latitude	Longitude		
65.5	-121.5	Runoff:	2
80	-121.5	Tide:	1
80	-74.5	Shelf width:	3
61	-54.5	June SST:	2
61	-65	Dec. SST:	1
57	-65	CZC:	2
57	-73.5	Major Ecosystem:	
65.5	-73.5	Sediment flux:	
65.5	-95.5	Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	3

LOICZ Name: **Hudson Bay** LOICZ No: **4**

Corner Points:		Variables:	
Latitude	Longitude		
49	-95.5	Runoff:	2
65.5	-95.5	Tide:	1
65.5	-73.5	Shelf width:	3
49	-73.5	June SST:	2
		Dec. SST:	1
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	3

LOICZ Name: **Bering Sea** LOICZ No: **5**

Corner Points:		Variables:	
Latitude	Longitude		
51	167	Runoff:	2
63.5	167	Tide:	2
63.5	160	Shelf width:	3
67	160	June SST:	2
51	180	Dec. SST:	2
65.5	-180	CZC:	3
65.5	-156	Major Ecosystem:	
58	-156	Sediment flux:	
52.5	-170	Boundary Current Strength:	
51.5	-180	Depth of Marginal Sea:	2
		Upwelling Strength:	
		Ice Cover:	2

LOICZ Name: **Aleutian** LOICZ No: **6**

Corner Points:		Variables:	
Latitude	Longitude		
51.5	-180	Runoff:	3
52.5	-170	Tide:	4
58	-156	Shelf width:	2
65.5	-156	June SST:	2
65.5	-150	Dec. SST:	2
51.5	-150	CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	2

LOICZ Name: Alaska Coast — LOICZ No: **7**

Corner Points:

Latitude	Longitude
51.5	-150
65.5	-150
65.5	-136
51.5	-136

Variables:

Runoff:	3
Tide:	4
Shelf width:	2
June SST:	2
Dec. SST:	2
CZC:	3
Major Ecosystem:	
Sediment flux:	
Boundary Current Strength:	1
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	2

LOICZ Name: West Coast of Canada — LOICZ No: **8**

Corner Points:

Latitude	Longitude
49	-136
65.5	-136
65.5	-121.5
49	-121.5

Variables:

Runoff:	3
Tide:	4
Shelf width:	2
June SST:	2
Dec. SST:	2
CZC:	3
Major Ecosystem:	4
Sediment flux:	
Boundary Current Strength:	1
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: West Coast of US — LOICZ No: **9**

Corner Points:

Latitude	Longitude
20	-136
49	-136
49	-121.5
40	-121.5
20	-108

Variables:

Runoff:	2
Tide:	2
Shelf width:	2
June SST:	3
Dec. SST:	3
CZC:	2
Major Ecosystem:	4
Sediment flux:	1
Boundary Current Strength:	
Depth of Marginal Sea:	
Upwelling Strength:	3
Ice Cover:	1

LOICZ Name: **Gulf of California** LOICZ No: **10**

Corner Points:		Variables:	
Latitude	Longitude		
40	-121.5	Runoff:	1
40	-100	Tide:	2
20	-100	Shelf width:	2
20	-108	June SST:	3
		Dec. SST:	3
		CZC:	2
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	2
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **West Central American Coast** LOICZ No: **11**

Corner Points:		Variables:	
Latitude	Longitude		
7	-108	Runoff:	3
20	-108	Tide:	2
20	-100	Shelf width:	2
17	-100	June SST:	4
17	-92	Dec. SST:	4
8.5	-82.5	CZC:	1
7	-82.5	Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Colombia Coast** LOICZ No: **12**

Corner Points:		Variables:	
Latitude	Longitude		
1	-82.5	Runoff:	3
8.5	-82.5	Tide:	4
8.5	-77.5	Shelf width:	2
1	-77.5	June SST:	4
		Dec. SST:	4
		CZC:	1
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Ecuador-Peru Coast** LOICZ No: **13**

Corner Points:

Latitude	Longitude
-18	-82.5
1	-82.5
1	-70
-18	-70

Variables:

Runoff:	3
Tide:	4
Shelf width:	2
June SST:	3
Dec. SST:	4
CZC:	2
Major Ecosystem:	1
Sediment flux:	2
Boundary Current Strength:	
Depth of Marginal Sea:	
Upwelling Strength:	3
Ice Cover:	1

LOICZ Name: **North Chile Coast** LOICZ No: **14**

Corner Points:

Latitude	Longitude
-35	-82.5
-18	-82.5
-18	-70
-35	-70

Variables:

Runoff:	2
Tide:	4
Shelf width:	2
June SST:	3
Dec. SST:	4
CZC:	2
Major Ecosystem:	1
Sediment flux:	2
Boundary Current Strength:	
Depth of Marginal Sea:	
Upwelling Strength:	3
Ice Cover:	1

LOICZ Name: **Central Chile Coast** LOICZ No: **15**

Corner Points:

Latitude	Longitude
-43	-82.5
-35	-82.5
-35	-70
-43	-70

Variables:

Runoff:	3
Tide:	4
Shelf width:	2
June SST:	3
Dec. SST:	3
CZC:	3
Major Ecosystem:	1
Sediment flux:	2
Boundary Current Strength:	
Depth of Marginal Sea:	
Upwelling Strength:	3
Ice Cover:	1

LOICZ Name: **South Chile Coast** LOICZ No: **16**

Corner Points:		Variables:	
Latitude	Longitude		
-60	-82.5	Runoff:	3
-43	-82.5	Tide:	4
-43	-70	Shelf width:	2
-60	-70	June SST:	2
		Dec. SST:	2
		CZC:	3
		Major Ecosystem:	1
		Sediment flux:	2
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	3
		Ice Cover:	1

LOICZ Name: **South Argentine Coast** LOICZ No: **17**

Corner Points:		Variables:	
Latitude	Longitude		
-60	-70	Runoff:	2
-43	-70	Tide:	5
-43	-62	Shelf width:	3
-60	-62	June SST:	2
		Dec. SST:	2
		CZC:	4
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Central Argentine Coast** LOICZ No: **18**

Corner Points:		Variables:	
Latitude	Longitude		
-43	-66	Runoff:	2
-34	-66	Tide:	5
-34	-55.5	Shelf width:	3
-43	-55.5	June SST:	2
		Dec. SST:	2
		CZC:	4
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **South Brazilian Bay** LOICZ No: **19**

Corner Points: Latitude	Longitude	Variables:	
-38	-55.5	Runoff:	2
-23	-55.5	Tide:	2
-23	-39	Shelf width:	3
-38	-39	June SST:	3
		Dec. SST:	3
		CZC:	3
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Abrolhos/Campos Coast** LOICZ No: **20**

Corner Points: Latitude	Longitude	Variables:	
-23	-44	Runoff:	2
-15	-44	Tide:	3
-15	-35	Shelf width:	2
-23	-35	June SST:	3
		Dec. SST:	3
		CZC:	1
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **East Coast of Brazil** LOICZ No: **21**

Corner Points: Latitude	Longitude	Variables:	
-15	-42	Runoff:	2
-8	-42	Tide:	3
-8	-32	Shelf width:	2
-15	-32	June SST:	4
		Dec. SST:	4
		CZC:	1
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: North East Brazil Coast LOICZ No: **22**

Corner Points: Latitude	Longitude	Variables:	
-8	-44.5	Runoff:	2
-2.5	-44.5	Tide:	3
-2.5	-32	Shelf width:	2
-8	-32	June SST:	4
		Dec. SST:	4
		CZC:	1
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: Amazon Shelf LOICZ No: **23**

Corner Points: Latitude	Longitude	Variables:	
-2.5	-61.5	Runoff:	3
8.5	-61.5	Tide:	4
8.5	-40	Shelf width:	3
-2.5	-40	June SST:	4
		Dec. SST:	4
		CZC:	2
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: Caribbean LOICZ No: **24**

Corner Points: Latitude	Longitude	Variables:	
17	-92	Runoff:	2
25	-81.5	Tide:	1
28	-73.5	Shelf width:	2
28	-56	June SST:	4
8.5	-56	Dec. SST:	4
8.5	-82.5	CZC:	2
		Major Ecosystem:	2
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	2
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Gulf of Mexico** LOICZ No: **25**

Corner Points:

Latitude	Longitude
17	-100
31.5	-100
31.5	-81.5
25	-81.5
17	-92

Variables:

Runoff:	2
Tide:	1
Shelf width:	3
June SST:	4
Dec. SST:	4
CZC:	2
Major Ecosystem:	1
Sediment flux:	
Boundary Current Strength:	
Depth of Marginal Sea:	2
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **South-Atlantic Bight** LOICZ No: **26**

Corner Points:

Latitude	Longitude
35.5	-81.5
35.5	-73.5
28	-73.5
25	-81.5

Variables:

Runoff:	2
Tide:	3
Shelf width:	2
June SST:	3
Dec. SST:	4
CZC:	1
Major Ecosystem:	4
Sediment flux:	
Boundary Current Strength:	2
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **Mid-Atlantic Bight** LOICZ No: **27**

Corner Points:

Latitude	Longitude
35.5	-78
41.5	-78
41.5	-66.5
35.5	-66.5

Variables:

Runoff:	2
Tide:	2
Shelf width:	2
June SST:	3
Dec. SST:	3
CZC:	1
Major Ecosystem:	4
Sediment flux:	
Boundary Current Strength:	2
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	

LOICZ Name: **Gulf of Maine** LOICZ No: **28**

Corner Points:

Latitude	Longitude
41.5	-73.5
46.5	-73.5
46.5	-65.5
45.5	-63
43.5	-66.5
40	-63.5
40	-66.5
41.5	-66.5

Variables:

Runoff:	2
Tide:	5
Shelf width:	3
June SST:	2
Dec. SST:	2
CZC:	3
Major Ecosystem:	
Sediment flux:	
Boundary Current Strength:	
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **Scotian Shelf** LOICZ No: **29**

Corner Points:

Latitude	Longitude
40	-63.5
43.5	-66.5
45.5	-63
45.5	-61.5
47.5	-60
40	-54

Variables:

Runoff:	2
Tide:	3
Shelf width:	3
June SST:	2
Dec. SST:	2
CZC:	3
Major Ecosystem:	
Sediment flux:	
Boundary Current Strength:	2
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **Gulf of St. Lawrence** LOICZ No: **30**

Corner Points:

Latitude	Longitude
46.5	-73.5
51	-73.5
51	-56
47.5	-60
45.5	-61.5
45.5	-63
46.5	-65.5

Variables:

Runoff:	2
Tide:	1
Shelf width:	3
June SST:	2
Dec. SST:	2
CZC:	3
Major Ecosystem:	
Sediment flux:	
Boundary Current Strength:	
Depth of Marginal Sea:	2
Upwelling Strength:	
Ice Cover:	3

LOICZ Name: **Newfoundland Shelf** LOICZ No: **31**

Corner Points: Latitude	Longitude	Variables:	
40	-54	Runoff:	2
47.5	-60	Tide:	2
51	-56	Shelf width:	3
51	-65	June SST:	2
61	-65	Dec. SST:	2
61	-54.5	CZC:	3
50	-43.5	Major Ecosystem:	
40	-43.5	Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	2

LOICZ Name: **West Greenland Coast** LOICZ No: **32**

Corner Points: Latitude	Longitude	Variables:	
50	-43.5	Runoff:	1
61	-54.5	Tide:	2
80	-74.5	Shelf width:	3
80	-43.5	June SST:	2
		Dec. SST:	1
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	3

LOICZ Name: **East Greenland Coast** LOICZ No: **33**

Corner Points: Latitude	Longitude	Variables:	
50	-43.5	Runoff:	1
80	-43.5	Tide:	4
80	-10	Shelf width:	2
60	-32.5	June SST:	2
		Dec. SST:	2
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	3
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	2

LOICZ Name: **Iceland Coast** LOICZ No: **34**

Corner Points:		Variables:	
Latitude	Longitude		
60	-32.5	Runoff:	2
80	-10	Tide:	1
60	-10	Shelf width:	2
0	0	June SST:	2
		Dec. SST:	2
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	2

LOICZ Name: **Barents Sea** LOICZ No: **35**

Corner Points:		Variables:	
Latitude	Longitude		
67.5	20	Runoff:	2
80	20	Tide:	2
80	55	Shelf width:	3
63.5	55	June SST:	2
63.5	32	Dec. SST:	1
67.5	32	CZC:	2
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	2

LOICZ Name: **Norwegian Coast** LOICZ No: **36**

Corner Points:		Variables:	
Latitude	Longitude		
66	-10	Runoff:	2
80	-10	Tide:	3
80	20	Shelf width:	2
67.5	20	June SST:	2
60	8.5	Dec. SST:	2
60	-2.5	CZC:	3
66	-2.5	Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	3
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	2

LOICZ Name: **Faroe Plateau** LOICZ No: **37**

Corner Points:

Latitude	Longitude
60	-10
66	-10
66	-2.5
60	-2.5

Variables:

Runoff:	1
Tide:	1
Shelf width:	2
June SST:	2
Dec. SST:	2
CZC:	3
Major Ecosystem:	
Sediment flux:	
Boundary Current Strength:	
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **North Sea** LOICZ No: **38**

Corner Points:

Latitude	Longitude
48	-2.5
60	-2.5
60	8.5
48	8.5

Variables:

Runoff:	2
Tide:	2
Shelf width:	3
June SST:	2
Dec. SST:	2
CZC:	3
Major Ecosystem:	4
Sediment flux:	
Boundary Current Strength:	1
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	2

LOICZ Name: **Baltic Sea** LOICZ No: **39**

Corner Points:

Latitude	Longitude
48	8.5
60	8.5
67.5	20
67.5	32
48	32

Variables:

Runoff:	2
Tide:	1
Shelf width:	1
June SST:	2
Dec. SST:	2
CZC:	3
Major Ecosystem:	1
Sediment flux:	
Boundary Current Strength:	
Depth of Marginal Sea:	1
Upwelling Strength:	
Ice Cover:	2

LOICZ Name: **Celtic-Biscay Coast** LOICZ No: **40**

Corner Points:		Variables:	
Latitude	Longitude		
43	-12	Runoff:	2
60	-12	Tide:	5
60	-2.5	Shelf width:	3
48	-2.5	June SST:	3
48	0	Dec. SST:	3
43	0	CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Iberian Coast** LOICZ No: **41**

Corner Points:		Variables:	
Latitude	Longitude		
36	-12	Runoff:	2
43	-12	Tide:	4
43	-5.5	Shelf width:	2
36	-5.5	June SST:	3
		Dec. SST:	3
		CZC:	2
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Mediterranean Sea** LOICZ No: **42**

Corner Points:		Variables:	
Latitude	Longitude		
30	-5.5	Runoff:	2
43	-5.5	Tide:	1
43	0	Shelf width:	1
48	0	June SST:	3
48	15	Dec. SST:	3
36	40	CZC:	1
30	40	Major Ecosystem:	4
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	2
		Upwelling Strength:	1
		Ice Cover:	1

LOICZ Name: **Black Sea** — LOICZ No: **43**

Corner Points:		Variables:	
Latitude	Longitude		
36	40	Runoff:	2
48	15	Tide:	1
48	44	Shelf width:	1
36	44	June SST:	3
		Dec. SST:	2
		CZC:	2
		Major Ecosystem:	4
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	2
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Morocco Coast** — LOICZ No: **44**

Corner Points:		Variables:	
Latitude	Longitude		
32	-12	Runoff:	2
36	-12	Tide:	2
36	-5.5	Shelf width:	2
32	-5.5	June SST:	3
		Dec. SST:	3
		CZC:	2
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	3
		Ice Cover:	1

LOICZ Name: **Sahara-Mauritania Coast** — LOICZ No: **45**

Corner Points:		Variables:	
Latitude	Longitude		
15	-20	Runoff:	1
32	-20	Tide:	2
32	-8	Shelf width:	2
15	-8	June SST:	3
		Dec. SST:	3
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	3
		Ice Cover:	1

LOICZ Name: **Drowned Coast** LOICZ No: **46**

Corner Points:		Variables:	
Latitude	Longitude		
-1	-20	Runoff:	3
15	-20	Tide:	2
15	-8	Shelf width:	2
-1	-8	June SST:	4
		Dec. SST:	4
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Gulf of Guinea** LOICZ No: **47**

Corner Points:		Variables:	
Latitude	Longitude		
-1	-8	Runoff:	3
8	-8	Tide:	2
8	11	Shelf width:	2
-1	11	June SST:	4
		Dec. SST:	4
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Congo Basin** LOICZ No: **48**

Corner Points:		Variables:	
Latitude	Longitude		
-12	8	Runoff:	3
-1	8	Tide:	2
-1	16	Shelf width:	2
-12	16	June SST:	4
		Dec. SST:	4
		CZC:	2
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Namibia-Angola Coast** LOICZ No: **49**

Corner Points: Latitude	Longitude	Variables:	
-27	10	Runoff:	2
-12	10	Tide:	2
-12	16	Shelf width:	2
-27	16	June SST:	2
		Dec. SST:	3
		CZC:	3
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	3
		Ice Cover:	1

LOICZ Name: **South African Coast** LOICZ No: **50**

Corner Points: Latitude	Longitude	Variables:	
-40	13	Runoff:	2
-27	13	Tide:	3
-27	35	Shelf width:	2
-40	35	June SST:	3
		Dec. SST:	4
		CZC:	1
		Major Ecosystem:	2
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Zambezi/Limpopo** LOICZ No: **51**

Corner Points: Latitude	Longitude	Variables:	
-27	33	Runoff:	2
-16	33	Tide:	3
-16	42	Shelf width:	3
-27	42	June SST:	3
		Dec. SST:	3
		CZC:	1
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	2
		Ice Cover:	1

LOICZ Name: **Madagascar** LOICZ No: **52**

Corner Points:		Variables:	
Latitude	Longitude		
-27	42	Runoff:	2
-16	42	Tide:	3
-16	45.5	Shelf width:	2
-11	45.5	June SST:	4
-11	51	Dec. SST:	3
-27	51	CZC:	1
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	2
		Ice Cover:	1

LOICZ Name: **Tanzania/Kenya Coast** LOICZ No: **53**

Corner Points:		Variables:	
Latitude	Longitude		
-16	37.5	Runoff:	2
2	37.5	Tide:	4
2	45.5	Shelf width:	2
-16	45.5	June SST:	4
		Dec. SST:	4
		CZC:	1
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	2
		Ice Cover:	1

LOICZ Name: **Somali Coast** LOICZ No: **54**

Corner Points:		Variables:	
Latitude	Longitude		
2	43.5	Runoff:	1
10	43.5	Tide:	4
10	51.5	Shelf width:	2
2	51.5	June SST:	4
		Dec. SST:	4
		CZC:	1
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	2
		Ice Cover:	1

LOICZ Name: **Arabian Sea** — LOICZ No: **55**

Corner Points:

Latitude	Longitude
5.5	51.5
10	51.5
10	56.5
27	56.5
27	77
5.5	77

Variables:

Runoff:	2
Tide:	2
Shelf width:	2
June SST:	4
Dec. SST:	4
CZC:	2
Major Ecosystem:	2
Sediment flux:	
Boundary Current Strength:	1
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **Gulf of Aden** — LOICZ No: **56**

Corner Points:

Latitude	Longitude
10	43.5
22	43.5
22	56.5
10	56.5

Variables:

Runoff:	1
Tide:	2
Shelf width:	2
June SST:	4
Dec. SST:	4
CZC:	1
Major Ecosystem:	2
Sediment flux:	
Boundary Current Strength:	1
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **Red Sea** — LOICZ No: **57**

Corner Points:

Latitude	Longitude
12.5	32.5
30	32.5
30	43.5
12.5	43.5

Variables:

Runoff:	1
Tide:	1
Shelf width:	1
June SST:	4
Dec. SST:	4
CZC:	1
Major Ecosystem:	2
Sediment flux:	
Boundary Current Strength:	
Depth of Marginal Sea:	2
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: Persian Gulf — LOICZ No: **58**

Corner Points: Latitude	Longitude	Variables:	
22	43.5	Runoff:	1
32	43.5	Tide:	1
32	56.5	Shelf width:	1
22	56.5	June SST:	4
		Dec. SST:	4
		CZC:	3
		Major Ecosystem:	3
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	1
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: Bay of Bengal — LOICZ No: **59**

Corner Points: Latitude	Longitude	Variables:	
5.5	77	Runoff:	3
27	77	Tide:	5
27	100	Shelf width:	2
13.5	100	June SST:	4
13.5	92.5	Dec. SST:	4
5.5	92.5	CZC:	1
		Major Ecosystem:	2
		Sediment flux:	3
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: Adaman Sea — LOICZ No: **60**

Corner Points: Latitude	Longitude	Variables:	
5.5	92.5	Runoff:	3
13.5	92.5	Tide:	2
13.5	100	Shelf width:	3
5.5	100	June SST:	4
		Dec. SST:	4
		CZC:	1
		Major Ecosystem:	2
		Sediment flux:	3
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Indonesia** LOICZ No: **61**

Corner Points:

Latitude	Longitude
-11	95
5.5	95
5.5	100
0	105.5
0	124.5
-7.5	142.5
-11	142.5

Variables:

Runoff:	3
Tide:	2
Shelf width:	3
June SST:	4
Dec. SST:	4
CZC:	1
Major Ecosystem:	2
Sediment flux:	3
Boundary Current Strength:	1
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **Northern Australian Shelf** LOICZ No: **62**

Corner Points:

Latitude	Longitude
-20	100
-11	100
-11	142.5
-20	142.5

Variables:

Runoff:	2
Tide:	4
Shelf width:	3
June SST:	4
Dec. SST:	4
CZC:	1
Major Ecosystem:	2
Sediment flux:	
Boundary Current Strength:	1
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **West Coast of Australia** LOICZ No: **63**

Corner Points:

Latitude	Longitude
-60	100
-20	100
-20	120
-28	120
-28	117
-60	117

Variables:

Runoff:	1
Tide:	1
Shelf width:	2
June SST:	2
Dec. SST:	3
CZC:	1
Major Ecosystem:	
Sediment flux:	
Boundary Current Strength:	3
Depth of Marginal Sea:	
Upwelling Strength:	
Ice Cover:	1

LOICZ Name: **Great Australian Bight** LOICZ No: **64**

Corner Points:		Variables:	
Latitude	Longitude		
-60	117	Runoff:	1
-28	117	Tide:	1
-28	142.5	Shelf width:	3
-60	142.5	June SST:	3
		Dec. SST:	3
		CZC:	1
		Major Ecosystem:	3
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **South East Coast of Australia** LOICZ No: **65**

Corner Points:		Variables:	
Latitude	Longitude		
-60	142.5	Runoff:	1
-28	142.5	Tide:	2
-28	160	Shelf width:	2
-60	160	June SST:	2
		Dec. SST:	3
		CZC:	1
		Major Ecosystem:	2
		Sediment flux:	
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **New Zealand Shelf** LOICZ No: **66**

Corner Points:		Variables:	
Latitude	Longitude		
-60	160	Runoff:	2
-33	160	Tide:	4
-33	180	Shelf width:	2
-60	180	June SST:	2
		Dec. SST:	3
		CZC:	2
		Major Ecosystem:	
		Sediment flux:	1
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Coral Sea** LOICZ No: **67**

Corner Points:		Variables:	
Latitude	Longitude		
-28	142.5	Runoff:	3
-7.5	142.5	Tide:	2
-7.5	160	Shelf width:	3
-28	160	June SST:	3
		Dec. SST:	4
		CZC:	1
		Major Ecosystem:	2
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Micronesia/Papua New Guinea** LOICZ No: **68**

Corner Points:		Variables:	
Latitude	Longitude		
0	124.5	Runoff:	3
10	140	Tide:	
10	160	Shelf width:	2
-7.5	160	June SST:	4
-7.5	142.5	Dec. SST:	4
		CZC:	1
		Major Ecosystem:	1
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Philippines Sea** LOICZ No: **69**

Corner Points:		Variables:	
Latitude	Longitude		
0	124.5	Runoff:	3
12.5	124.5	Tide:	2
12.5	121	Shelf width:	2
24.5	121	June SST:	4
32.5	131.5	Dec. SST:	4
38.5	140	CZC:	2
10	140	Major Ecosystem:	4
		Sediment flux:	1
		Boundary Current Strength:	2
		Depth of Marginal Sea:	
		Upwelling Strength:	1
		Ice Cover:	1

LOICZ Name: **Sulu-Celebes Seas** LOICZ No: **70**

Corner Points:		Variables:	
Latitude	Longitude		
0	117	Runoff:	3
8	117	Tide:	1
12.5	121	Shelf width:	2
12.5	124.5	June SST:	4
0	124.5	Dec. SST:	4
		CZC:	1
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	2
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **South China Sea** LOICZ No: **71**

Corner Points:		Variables:	
Latitude	Longitude		
5.5	100	Runoff:	3
24.5	100	Tide:	1
24.5	121	Shelf width:	3
12.5	121	June SST:	4
8	117	Dec. SST:	4
0	117	CZC:	1
0	105.5	Major Ecosystem:	1
		Sediment flux:	2
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **East China Sea** LOICZ No: **72**

Corner Points:		Variables:	
Latitude	Longitude		
24.5	115	Runoff:	3
32.5	115	Tide:	5
32.5	131.5	Shelf width:	3
24.5	121	June SST:	4
		Dec. SST:	3
		CZC:	3
		Major Ecosystem:	1
		Sediment flux:	3
		Boundary Current Strength:	2
		Depth of Marginal Sea:	1
		Upwelling Strength:	1
		Ice Cover:	1

LOICZ Name: **Yellow Sea** LOICZ No: **73**

Corner Points:		Variables:	
Latitude	Longitude		
32.5	115	Runoff:	2
42.5	115	Tide:	5
42.5	124.5	Shelf width:	3
32.5	131.5	June SST:	3
		Dec. SST:	2
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	3
		Boundary Current Strength:	2
		Depth of Marginal Sea:	1
		Upwelling Strength:	1
		Ice Cover:	1

LOICZ Name: **Sea of Japan** LOICZ No: **74**

Corner Points:		Variables:	
Latitude	Longitude		
42.5	120	Runoff:	2
53	120	Tide:	1
53	142	Shelf width:	2
40	142	June SST:	2
38.5	140	Dec. SST:	3
32.5	131.5	CZC:	3
42.5	124.5	Major Ecosystem:	
42.5	115	Sediment flux:	1
		Boundary Current Strength:	1
		Depth of Marginal Sea:	2
		Upwelling Strength:	1
		Ice Cover:	1

LOICZ Name: **Oyashio Current** LOICZ No: **75**

Corner Points:		Variables:	
Latitude	Longitude		
32	140	Runoff:	2
38.5	140	Tide:	1
40	142	Shelf width:	2
63.5	167	June SST:	2
32	167	Dec. SST:	3
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	1
		Boundary Current Strength:	3
		Depth of Marginal Sea:	2
		Upwelling Strength:	1
		Ice Cover:	1

LOICZ Name: **Sea of Okhotsk** LOICZ No: **76**

Corner Points:		Variables:	
Latitude	Longitude		
40	142	Runoff:	2
53	142	Tide:	5
53	133	Shelf width:	3
63.5	133	June SST:	2
63.5	167	Dec. SST:	1
		CZC:	3
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	2

LOICZ Name: **Kara/Laptev/Siberian Sea** LOICZ No: **77**

Corner Points:		Variables:	
Latitude	Longitude		
63.5	55	Runoff:	2
80	55	Tide:	1
80	180	Shelf width:	3
67	180	June SST:	2
67	160	Dec. SST:	1
63.5	160	CZC:	0
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	1
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	3

LOICZ Name: **Pacific Ocean** LOICZ No: **78**

Corner Points:		Variables:	
Latitude	Longitude		
-33	160	Runoff:	2
10	160	Tide:	1
10	140	Shelf width:	2
32	140	June SST:	4
32	167	Dec. SST:	4
51	167	CZC:	1
51	180	Major Ecosystem:	
0	180	Sediment flux:	
-33	180	Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover	1

LOICZ Name: **Pacific Ocean 2** LOICZ No: **78**

Corner Points:		Variables:	
Latitude	Longitude		
-60	-180	Runoff:	2
0	-180	Tide:	1
51.5	-180	Shelf width:	2
51.5	-136	June SST:	4
20	-136	Dec. SST:	4
20	-108	CZC:	1
7	-108	Major Ecosystem:	
7	-82.5	Sediment flux:	
-60	-82.5	Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	1

LOICZ Name: **Atlantic Ocean** LOICZ No: **79**

Corner Points: Variables:

Latitude	Longitude		
-2.5	-32	Runoff:	2
-2.5	-40	Tide:	2
8.5	-40	Shelf width:	2
8.5	-56	June SST:	4
28	-56	Dec. SST:	4
28	-73.5	CZC:	
35.5	-73.5	Major Ecosystem:	
35.5	-66.5	Sediment flux:	
40	-66.5	Boundary Current Strength:	
40	-43.5	Depth of Marginal Sea:	
50	-43.5	Upwelling Strength:	
60	-32.5	Ice Cover:	1
60	-12		
32	-12		
32	-20		
-1	-20		

LOICZ Name: **Atlantic Ocean 2** LOICZ No: **79**

Corner Points: Variables:

Latitude	Longitude		
-60	-62	Runoff:	2
-43	-62	Tide:	2
-43	-55.5	Shelf width:	2
-38	-55.5	June SST:	4
-38	-39	Dec. SST:	4
-23	-39	CZC:	1
-23	-35	Major Ecosystem:	
-15	-35	Sediment flux:	
-15	-32	Boundary Current Strength:	
-2.5	-32	Depth of Marginal Sea:	
-1	-20	Upwelling Strength:	
-1	8	Ice Cover:	
-12	8		
-12	10		
-27	10		
-27	13		
-40	13		
-40	20		

LOICZ Name: **Indian Ocean** LOICZ No: **80**

Corner Points: Variables:

Latitude	Longitude	Variables	
-60	20	Runoff:	2
-40	20	Tide:	2
-40	35	Shelf width:	2
-27	35	June SST:	4
-27	51	Dec. SST:	4
-11	51	CZC:	1
-11	45.5	Major Ecosystem:	
2	45.5	Sediment flux:	
2	51.5	Boundary Current Strength:	
5.5	51.5	Depth of Marginal Sea:	
5.5	95	Upwelling Strength:	
-11	95	Ice Cover:	1
-11	100		
-60	100		

LOICZ Name: **Antarctic** LOICZ No: **81**

Corner Points: Variables:

Latitude	Longitude	Variables	
-90	-180	Runoff:	1
-60	-180	Tide:	1
-60	180	Shelf width:	2
-90	180	June SST:	1
		Dec. SST:	1
		CZC:	2
		Major Ecosystem:	
		Sediment flux:	
		Boundary Current Strength:	
		Depth of Marginal Sea:	
		Upwelling Strength:	
		Ice Cover:	3