Exchange Mechanism for Global Mapping

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Abstract. This paper describes findings and results of the research realized for the Global Mapping Project, with the cooperation of Geographic Survey Institute (GSI), Japan, in order to set the procedures for converting cartographic digital data in vector format, produced at IBGE, at 1 to 1million scale, to Global Map specifications.

1. Introduction

The Global Mapping Project, led by the International Steering Committee for Global Mapping (ISCGM) have its roots on the results of the United Nations Conference on Environment and Development (UNCED), held in Brazil in 1992, and on the report of the Special Session of the United Nations General Assembly on the Implementation of Agenda 21, held in June 1997, stressing the importance of public access to globally mapped information and of international cooperation in making it available.

A Global Map (GM), or a group of global digital geographic datasets, is the expected resultant product of the Global Mapping Project. According to the GM Specifications [3], the main objective of Global Mapping Project is to bring all nations and concerned organizations together to develop and provide easy and open access to global digital geographic information, at a scale of 1:1 million, to facilitate the implementation of global agreements and conventions for environmental protection, for monitoring environmental phenomena and for encouraging sustainable development.

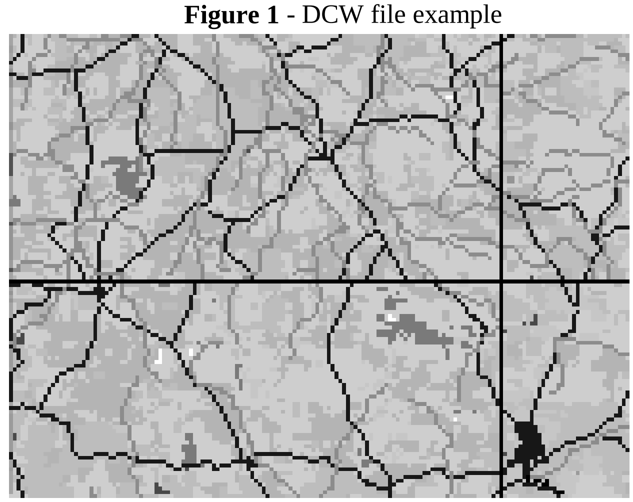
The first phase of the Project, up to year 2000, involves gathering digital geographic information, at global map scale, organized into thematic layers, or coverages, either in vector form (baseline features) or raster form (elevation, land cover, land use and vegetation), through international cooperation of national mapping organizations.

All countries are encouraged, by ISCGM, to participate according to their capacity of developing suitable data for other countries (level A) or for its own territory (level B), or even only by inputting data to be developed by a third party (level C).

Brazil, through its National Mapping Agency (Brazilian Institute of Geography and Statistics – IBGE) joined the Global Mapping Project in 1999, as a level B participant country, after being invited to integrate the project, since its participation at the VI United Nations Regional Cartographic Conference for the Americas, on July 1997, at New York, where the Global Mapping Project was object of special attention. Before joining officially the Project, IBGE participated at the Global Mapping Meeting at Gifu, Japan, on November at the same year, where it was requested the support of National Mapping Agencies for the implementation of the project until the end of year 2000.

As a consequence, it was offered to IBGE the opportunity to send a participant for the Global Mapping (Environment) Course held in Japan, from May to August, 1998. During the Course it was tried to use the existent vector digital dataset from the Digital Chart of the World (DCW), referent to the CIM sheet of Goiânia (SE-22), but it was verified that data was out of date and tiles didn’t mach properly, needing edition, as shown in Figure 1.

Figure 1 - DCW file example



2. Information in digital format for conversion

Many countries, like Brazil, which are participating of Global Mapping Project, are being encouraged by the International Steering Committee for Global Mapping (ISCGM) to convert their paper maps from many different digital formats, using a variety of systems, database structures and a different set of attributes for defining spatial entities, specially in terms of baseline features, to the Global Map specifications or, at least, to a format compatible with VPF, which can be used by ISCGM to distribute the datasets. Some of these digital databases can be used directly in Geo Information Systems (GIS) others are ready only for Cartographic purposes or for map sheets printing.

Exchanging data related with Global Mapping Project implies on both importing from VPF to a particular system and exporting from any system to VPF format. A first step can be taken by using any existent digital data and convert it to VPF, directly or through other formats which can be readily used by participating countries. It doesn't exist an appropriate method which can fulfill all needs of all users. Each case must be seen as a particular case but there are some basic procedures that are common to the process as a whole.

3. Software systems for producing and converting digital information

Different software systems are used for digital databases production and management, either for cartographic or GIS purposes. Among many of them, we can mention, for example:

- Intergraph MGE (based on ODBC/ACCESS, Oracle or Informix) [7];
- ESRI ArcInfo (ArcView) [6];
- Bentley Microstation (Geographics) [5];

Import and export from one software system to another, inside a GIS environment, is still a hard task. It is difficult to find a software which can fully read any other format. All GIS software have significant limitations in converting from one format to another, according to the complexity of their importing and exporting functions, despite the effort of software suppliers on overcome it.

4. CIM Project

The International Chart of the World at 1 to 1 million (1:1,000,000) scale (CIM), of the Brazilian Territory, has been produced by the Brazilian Institute of Geography and Statistics (IBGE) according to the "Manual of Rules, Specifications and Technical Procedures" [1]. These rules were adopted at Bonn's United Nations Technical Conference about the International Chart of the World at 1 to 1 million scale, in 1962, after the revision of London (1909) and Paris (1913) resolutions.

The "Manual" [1] aimed at standardize the procedures for making cartographic originals at 1 to 1 million scale, representing the geographic space mainly by hydrography (drainage), hipsography (elevation), and relevant planimetric elements, necessary for the physical and social characterization of a territory.

The Brazilian territory is covered by a set of 46 CIM sheets (or tiles) which give support for the realization of strategic studies and territorial analysis in a national scale. These sheets are also used as a support for building other cartographic documents, at smaller scales, which will compose the base for representing thematic subjects like population distribution, soils, geology and vegetation, among others.

The preparation of the new version of 1:1,000,000 sheets, which started in 1993, was concluded in 1998 and printed in 1999. IBGE, through the Department of Cartography, made a revision of the necessary procedures and elaborated a new version for the "Manual" (1), attending to the rules of Bonn's agreement about the International Chart of the World at 1 to 1 million (1:1,000,000) scale (CIM), at the UN Technical Conference.

The project of converting the 1:1,000,000 paper sheets to digital format, named CIM Project, is meant to both cartographic purpose and for being used by GIS systems, mainly on Intergraph MGE environment, which is the main software system used at IBGE. The CIM database was structured to fit with this system and to fulfill other cartographic requests.

The first phase of the process for converting the 46 sheets at 1:1,000,000 scale to digital format, by IBGE, started in the beginning of 1998 and involved the conversion from paper maps to raster files by scanning all the cartographic originals used for composing the new edition. By the middle of 1999 the raster files, obtained through this process, started to be converted from raster to Intergraph .DGN vector format files. This work is being carried out by a third party contracted by the National Agency of Electric Energy (ANEEL) in urgent need of a reliable digital database to support energetic development plans. The next necessary steps to be taken are: to codify the vectorized files, to link them with the attributes database, to build topology and to produce new data at smaller scales for regional and national planning. Database is still based on ODBC/ACCESS environment, but will be converted to Oracle system in a near future.

The system selected to realize this work was Intergraph MGE system which comprises raster as well as vector modules and is already spread through several Departments at IBGE. By the end of March 2000 the vectorization of the 46 sheets was completed and ready to be structured topologicaly.

The cartographic originals (blue, red, yellow, green and black) where split in 9 different vector files, or layers, for each sheet, according to the categories specified at the Digital Topographic Map Library (MTD) structure: hypsography (contour line, height), limit (political-administrative limit), hydrography (river, canal, lake, shoreline), vegetation (marshland, mangrove), locality (city, village, capital), transportation system (road, railroad, train station), works and buildings (breakwater, sea wall, lighthouse, plant, cemetery, rural building).

The 1:1.000.000 scale digital database, coming from the International Chart of the World (CIM) and covering all the territory will be used for building other databases at smaller scales and for the Global Map Project. This means IBGE will be able to produce its own data for the Global Map.

The Department of Cartography (DECAR) is in charge of producing vector data for the Global Map Project, which will be adapted from the CIM Project. The Department of Natural Resources (DERNA) will be in charge of producing data related with vegetation, land use and land cover. Elevation data can be obtained from the existent vector database through the contourlines and other elevation data. Political boundaries, at Municipal level, were added to CIM Project and to the Global Map Project from de existent Digital Municipal Boundary 1997 database. By the end of the year 2000, It will be incorporated the new Digital Municipal Boundary used for the Census 2000.

Digital data representing CIM sheets are grouped in classes of cartographic elements which are assembled in the categories shown at Table 1.

Table 1 - CIM Categories

CATEGORY NUMBER (*)	CIM CATEGORY	CATEGORY CODE
01	hypsography (elevation)	hp
02	limit (boundary)	lm
04	hydrography (drainage)	hd
05	vegetation	vg
06	locality (place, site)	lc
07	transportation system	st
09	work and building 02 (structures)	o2

(*) The category code number 03 corresponds to the category referential point (survey point, landmark) which elements are not represented at CIM Project; elements of the categories 08 and 10, work and building 01 and 03, are incorporated at the work and building 02.

The structure of MTD database which has been applied to Global Map CIM Project has been built based on Intergraph MGE structure on ODBC/ACCESS system, and comprises: categories, features, attributes and domains for the attribute values. **Table 2**, shows an example of the structure for MTD category HIDROGRAPHY.

Data obtained through the vectorization process will be codified, linked with the attributes in the database and topologically structured. For being used by the Global Map Project, however, these files need to be compatible with Global Map specifications and to be converted to VPF format. The alternatives affordable to accomplish this task, by the time of the research were:

1) Using SDTS module, inside Intergraph MGE System, to create an output which can be used by another System to create VPF files;

2) Using Bentley GEOEXCHANGE System, to create an ARC/INFO file or an ARCVIEW "shape" file to be used for further conversion to VPF;

3) Creating a new project using .DGN graphic files and ACCESS database tables, in an ARCINFO/ARCVIEW environment for exporting to VPF format through the programs already created for this.

6. GM Project

According to GM Specifications [3] (pg. 29/30), the Global Map product will encompass the entire globe, at a scale of 1:1 million. For accomplish this task, data sets must be consistent with either the scale and the specifications. Spatial features are organized into thematic layers or "coverages" each containing logically related geographic information. For the purpose of this research, only vector form layers were considered. The features of the vector data model, on these layers, which will be comprised of three spatial objects: points, edges, and faces, can be seen at **Table 3**.

Still according to the Specifications [3], vector features will be selected on the basis of their suitability for 1:1 million scale mapping. As a result of this, some features may occur only in less densely areas where they are referentially more important.

Global Map thematic coverages share the same coordinate system and tiling structure. The tiling schema adopted for Brazil have the dimensions of 5 x 5 degrees.

7. Comparison

CIM Project and GM project databases are different and structured diversely. The correspondence between layers, features and attributes can be evaluated through the Tables 4, 5 and 6.

Table 4 - Correspondence between CIM Project categories and GM Specifications categories

CIM Category Name	GM Category Name
hipsography (elevation)	elevation (raster)
limit (boundary)	boundaries
hidrography (drainage)	drainage
vegetation	vegetation (raster)
locality (place, site)	population centers
transportation system	transportation
works and building (structure) 02	not on an specific layer

Features from CIM project are comprised on 7 categories. A full correspondence among layers of categories was not encountered. In some categories like drainage and transportation many features are compatible, but in others like boundaries and population centers there was some difficulty for making the correspondence with Global Map mandatory features, like the coast line which doesn't exist as a separate feature on CIM Project. The works and building category has no correspondence at all.

While Global Map specifications foresee the features representing the vector data model comprising of three spatial objects: points, edges and faces, besides text, CIM project works with 6 different spatial objects, including text. (See Table 5a and 5b)

Table 5a - Spatial objects representing vector features at MTD (MGE)

CIM Object type	CIM object description
point	(*)object with no dimensional representation
line	(*)object which extension can be represented
area boundary	object with two dimensions represented
area centroid	(*) point inside the area boundary
closing line	imaginary line for closing an area boundary
text centroid	point to which is assigned a text

(*) object connected to an attribute table

Table 5b - Spatial objects representing vector features according to GM Specifications

GM Object type	GM Object description [3]
point	0-dimensional geometric primitive
edge	1-dimensional topologic primitive
face	2-dimensional topologic primitive
text	text

The topological structure used inside Intergraph MGE environment doesn't configure an area or a polygon with attributes but, instead, an area boundary associated with a centroid which contains the attributes of the polygon represented by this area boundary. This centroid in some cases can be considered a point feature as well, which can cause some confusion.

Some attributes and features related to a Global Map coverage are similar to the ones of CIM Project; others are contained in a different layer of CIM Project or just don't exist. The distribution of spatial objects or features among categories is also not the same in both projects. "Dam/weir" included in the "drainage" coverage of Global map project, for example, must be extracted from the category "work and building 02 (structures)" from CIM Project. These incompatibilities, which can be seen at **Table 6**, require that some extra preparation work must be done in order to make features and attributes usable for the Global Map Project.

Political boundaries are obtained from the Digital Municipal Boundary 1997 database, which has been developed for ARCINFO environment and adapted to CIM Project prior of being used directly for Global Map.

8. Hypothesis

Two possibilities were figured out as being the most suitable to fulfill the task of building the Global Map CIM Project.

The first one - and apparently the easiest one - was to maintain the structure and codes from CIM Project, in Portuguese, and convert them to Global Map, in a way that feature names and attributes are converted to English and to Global Map specifications on the process; the second one, to structure a completely new project, based on MTD structure at MGE environment, in English, following GM features specifications, to be exported directly to Global Map.

9. Research

The main purpose of the research was to evaluate which was the best way to use existent digital data from IBGE's CIM Project, in order to produce Global Map tiles of Brazilian territory in VPF format.

Data used on the research tests came from the digital database, rasterized and vetorized with Intergraph MGE System, derived from 1:1,000,000 existent CIM cartographic originals.

It was selected a file representing a single CIM sheet from the digital database with graphic features connected to its attributes, codified and topologically structured, containing all categories and a representative number of features, in order to test the first possibility outlined in the hypothesis, and the behavior of different features (objects). A political boundary file, required by GM specifications, was composed with the coastline feature taken from the drainage database, once at the moment of the research, the category "political boundaries" file was not yet available for CIM Project.

The first alternative tested was to convert directly from Intergraph MGE system using SDTS module. Because the existent version of Intergraph MGE Modules, at IBGE, is working based on an ODBC/ACCESS database system, it was not possible to use the SDTS module, which needs a database schema system not applicable for the existent database.

Using Bentley GEOEXCHANGE System was possible to create ARC/INFO files and ARCVIEW "shape" files which could be used for conversion to VPF.

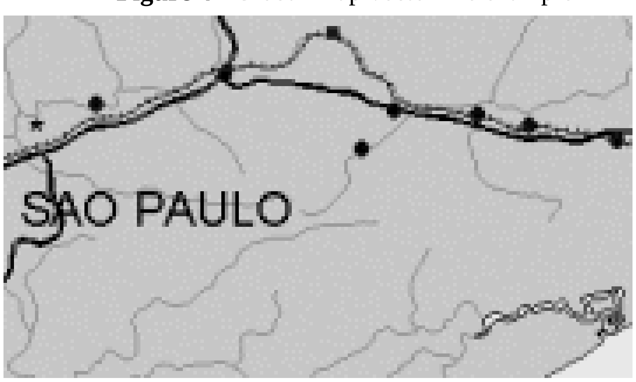
A brief explanation about the sequence for GeoExchange conversion process, starts by setting the database contained in the directory of the Intergraph MGE project for ODBC system. It's not necessary to build a new project if a MGE project is already structured in a particular directory. It is necessary only to open the file to be converted on GeoExchange, to open the existent MGE project, to set the necessary variables and to export the file. GeoExchange exports, separately, each feature contained on the file.

Point and line features hardly presented any problem on the conversion, but polygons were object of some struggle before being properly exported and used on the next steps. For being exported from Intergraph MGE system, the area boundaries need to be "complexed" with the area centroids to generate a "face" type output required by Global Map specifications. GeoExchange, however, don't export completely these polygons when they have other polygons (holes) inside, like lakes on islands or islands on lakes. It's necessary to separate these features before exporting.

To convert CIM Project files to the tiles with GM specifications, ARCINFO software was used as an intermediary step. After exporting the selected features from CIM files, through Geoexchange, to the ArcInfo .E00 or shape file formats, it is necessary to import them into ArcInfo coverages. The conversion process to VPF, uses the "VPFkit for Global Map" built with the Production Line Tool Set (PLTS) from ESRI [6].

The final Global Map sample product, obtained from CIM Project files converted to VPF format, through the procedures executed during the research, can be seen with ARCVIEW software [6] as exemplified in Figure 4. Its features structure is shown in the Table 7.

Figure 4 - Global Map vector file example



As the second alternative tested, using Bentley's GeoExchange software and the programs already developed in ARCINFO environment by GSI, fulfilled the needs to convert data from Intergraph MGE to Global Map VPF, for the purpose of this research, it was not necessary to test the third one.

Table 7 – Global Map structure at VPF

GM VPF Layer	Cov. Name	GM VPF Feature	Feat. Type	Feat. Code	Global Map Feature Description
Hydro-graphy	hydro	miscp	point	BA030	Island smaller then 1 km2
		watrcrsl	edge	BH140	Water course, river, stream
		miscl	edge	BI020	Dam, Weir
		inwatera	face	BH000	Inland water area
				BH090	Land subject to inundation

10. Conclusions

In order to fulfill the requests of a final product which fits with Global Map specifications, some extra initial work must be done with CIM files to avoid future troubles. This work implies in some adaptation, separation and aggregation of features in different layers, as it has been done with the coast line feature created from CIM category "hydrography" to compose the Global Map "political boundaries" coverage.

The first problem faced is the way the feature name is written in the CIM database. As outlined on the first hypothesis, the database was maintained in the way it was structured for CIM Project, in Portuguese. Intergraf MGE and the Microsoft ACCESS internal structures allow the use of blank spaces but ArcInfo "import command" doesn't recognize it. GeoExchange, on the conversion process, maintain the original name and doesn't allow any change or edition. As soon as the features are exported it is necessary to edit their names, eliminating or substituting the blank spaces, allowing ArcInfo "import command" to work properly.

Point features and line features tested, hardly presented problems on the conversion process. Polygon features, meanwhile, had to be edited and tested many times, in different ways, to find the right way to use them in the sequence of conversion procedures from MGE to ArcInfo, through GeoExchange, and latter to VPF through "VPFKit". The perfect solution, however, couldn't be found. Polygon holes on complexed area boundary features aren't exported by GeoExchange directly and had to be worked separately, which complicates automation procedures.

Island point feature doesn't exist on CIM Project database as a separate entity. For Global Map project it will represent all islands with less then 1 square km. This is a subject to be considered on the further development of the project because all islands which appears on CIM database are composed by an area boundary with an area centroid containing the attributes, independently of their size.

The Global Map boundary feature "coast line" doesn't exists as a separate feature on CIM database but as an attribute of a political administrative boundary line feature. In this way it will be possible to make a specific query to export it separately. The same problem occurs with ocean/sea boundary feature. At the CIM database "ocean" is an attribute of a "permanent water body" area centroid feature from the category Hydrography. By querying and "complexing" it with the area boundary feature it is possible to create a new feature to be exported to the Global Map coverage "political boundaries".

Other problem encountered, and which had to be worked out during the conversion procedures, is related with projection, coordinates and working units. The digital database derived from CIM cartographic originals was built on Lambert Conformal Conic Projection, with Corrego Alegre Datum, using the unit "degrees, minutes and seconds" for longitude and latitude coordinates, and working unit of 10000 UOR per km (Units of Resolution or the smallest unit of accuracy at which a point can be located within a design area) for measurements.

All this had to be converted in ARCINFO before exporting to VPF. Degrees, minutes and seconds were converted to decimal degrees and the units of resolution from Km to m using the conversion factor 0,001 meters. Conversion parameters are necessary to adapt projections and working units to Global map specification.

A new database in English, built on Intergraph MGE structure, but using GM specification for features and attributes can be used in the future for testing the second hypothesis. It could facilitate the conversion process, eliminating some steps. The names of the features in the proposed database are proper to conversion without blank spaces. Global Map feature code was added to the project structure as an attribute, in this way there won't be problems of code repetition for different feature objects in Global Map structure once MGE code structure doesn't allow code repetition for different elements. The structure of MTD codes was maintained in order to keep the link with CIM Project, specially, because features for composing GM categories came from different CIM categories, for example, "dam/weir" from the category "work and building 02 (structures)" to the coverage "drainage" and "ocean/sea" from the "hydrography" to the "political boundaries".

The model of the proposed structure for a database for further conversion from an MGE project to a Global Map Project can be seen at **Table 8**.

For the scope of CIM Project it will be useful to include in the Global Map CIM Project the feature "land subject to inundation", at "Inland water" feature table, because it is a valuable information for environmental development projects. Some other features existent and codified in both databases, such as depth line, pier, danger points, rapids, waterfall, breakwater, sea wall, native settlement and lighthouse, could also be included when available.

As a final remark, it will be very useful and helpful for Global Map CIM Project if a solution to convert digital data directly from Integraph MGE to VPF format could be find.

11. References

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[3] Secretariat of International Steering Committee for Global Mapping - ISCGM, *Report of the Fifth Meeting of International Steering Committee for Global Mapping, Canberra, Australia*, GSI, 1998.

[4] Secretariat of International Steering Committee for Global Mapping - ISCGM, *Explanation for Vmap Level 0 in ArcInfo Export format*, 1999.

[5] Bentley Systems Brasil (GeoExchange, Geographics, MicroStation-SE), http://www.bentley.com.br.

[6] ESRI – Environmental System Research Institute, Inc. (ArcInfo/ArcView), http://www.esri.com.

[7] Sisgraph Ltda. (Intergraph MGE)

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[8] . Secretariat of International Steering Committee for Global Mapping - ISCGM, *Report of the Sixty Meeting of International Steering Committee for Global Mapping, Cambridge, England*, GSI, 1999.

Table 2 - Example of MTD (Intergraph MGE/ACCESS) structure (Categories, Features, Attributes and Domains) for the CIM Project category **HIDROGRAFIA** (hydrography, **drainage**)

Feature Name	Feat. Code	Feat. Attribute Table	Feature Type	lv	co	s	w	Attribute Field	Do Nr	Domain Name	Attribute Value Table	Att. Val	Value Description
CONTORNO HD PERMANENTE LIM (**permanent water body**)	04302		area boundary	1	71	0	1						
CONTORNO HD PERMANENTE (**permanent water body**)	04402	tbhd_mas_agua	area centroid	1	0	0	0	mslink	0				
								mapid	0				
								nm_nome (**name**)	0				
								nm_rio_associado (**river name**)	0				
								md_ar_poli (**area**)	0				
								cd_classificacao (**water body type**)	14	HDDOM01	hdclassificacao	1	baia (**bay**)
												2	rio (**river**)
												3	furo (**hole**)
												4	parana (**estuary**)
												5	vala (**ditch**)
												6	oceano (**ocean**)
												7	canal (**canal**)
												8	lago (**lake**)
												9	lagoa (**lagoon**)
												10	represa (**dam**)
								cd_navegabilidade (**navigation**)	15	HDDOM02	hdnavegabilidade	1	navegavel (**navigable**)
												2	não navegavel (**not navigable**)
												3	nao identificado (**unidentified**)
								cd_fluxo (**flow**)	16	HDDOM03	hdfluxo	1	permanente (**permanent**)
												2	intermitente (**intermittent**)
												3	nao identificado (**unidentified**)
ILHA (**island**)	04403	tbhd_ilha	area centroid	54	117	0	0	mslink	0				
								mapid	0				
								nm_nome_ocor (**name**)	0				
								md_ar_poli (**area**)	0				
								cd_tipo_ilha (**island type**)	22	HDDOM09	hdtipoilha	1	fluvial (**river island**)
												2	maritima (**sea island**)
												3	outras (**other**)
												4	nao identificado (**unidentified**)
DELIMITADOR HD	04599		area boundary	62	23	5	0						

Table 8 - Example of Global Map CIM Project (Intergraph MGE/ACCESS) structure (Categories, Features, Attributes and Domains) for the Global Map coverage **DRAINAGE**

Feature Name	Feature Code	Feature Attribute Table	Feature Type	lv	co	st	we	Attribute Field	Do Nr	Domain Name	Attribute Value Table	Attribute Value	Value Description
island	04403	tbdr_island	point	54	117	0	0	mslink	0				
								mapid	0				
								f_code	0			BA030	
								nm_nam_island	0				
inland water	04302	tbdr_inland_water	face	2	72	0	1	mslink	0				
								mapid	0				
								f_code	0			BH001	
								nm_nam_inland_wate	0				
								cd_hyc	23	DRDOM01	hydrologicalcateg	0	unknown
												6	non-perennial /intermittent/fluctuating
												8	perennial/permanent
water border	04599		edge	62	23	5	0						
water text	04601		text	61	61	0	0						

Table 3 - Example of Global Map Specifications Vector Data [3] for the Global Map coverage **Drainage**

All features will have an additional attribute. This attribute will identify the source country for the data. Definitions in this dictionary are taken from DIGEST Edition 2.0 02 June 1997. Field size of * is a variable length field and may be of any length.

Feature Name	Feature Code Description	Definition	Feature Class	Attributes	Field name	Field type	Field size	Value type/codes	Value Description or Example
Miscellaneous	**Dam/Weir**	A permanent barrier across a watercourse used to impound water or to control its flow.	point, edge	FACC feature code	f_code	Character text string	5	BI020	
	Island	A land mass smaller than a continent and surrounded by water.	point	FACC feature code	f_code	Character text string	5	BA030	
	Spring/Water-Hole	A natural outflow of water from below the ground surface.	point	FACC feature code	f_code	Character text string	5	BH170	
Aqueduct/Canal/ Flume/ Penstock	**Inland Water**	A pipe or artificial channel designed to transport water from a remote source, usually by gravity. A man-made or improved natural waterway used for transportation. An open, inclined channel which carries water for use in such operations as mining or logging. A pipeline or channel generally used by hydroelectric plants or water mills to transport water by gravity or under pressure.	edge	FACC feature code Existence Category Location Category	f_code exs loc	Character text string Number (short integer) Number (short integer)	5 1 1	BH000 0 1 5 6 0 4 8 25	Unknown Definite Under Construction Abandoned/Disused Unknown Below Surface/Submerged /Underground On Ground Surface Suspended or Elevated Above Ground or Water Surface.
Water Course	River/Stream	A natural flowing watercourse.	edge	FACC feature code Hydrological Category Name	f_code hyc nam	Character text string Number (short integer) Character text string	5 1 *	BH140 0 6 8 UNK **Actual value**	Unknown Non-Perennial/ Intermittent/ Fluctuating Perennial/Permanent unknown **NILE**
Inland Water	Inland Water	Any known inland waterway body, such as: lake/pond, reservoir, river/stream, etc. requiring separation into individual features due to status/type grouping that is currently indeterminable.	face	FACC feature code Hydrological Category Name	f_code hyc nam	Character text string Number (short integer) Character text string	5 1 *	BH000 0 6 8 UNK **Actual value**	Unknown Non-Perennial/ Intermittent/ Fluctuating Perennial/Permanent unknown **LAKE TANGANYIKA**
Water text	**Text**	Feature names positioned to allow production of a cartographic product.	text	text					Feature name

Table 6 - Example of the correspondence between CIM Project and Global Map Project Categories, Features and Attributes for **Inland Water** features at the GM Layer **Drainage**

CIM Feature Name	**CIM Feture Code**	**CIM Feature Type**	**CIM Attribute Table**	**CIMfield**	**CIMvalue_ type**	**CIMvalue_descr**	**GM Value Description**	**GM Value type/ codes**	**GM Field name**	**GM Attributes**	**GM Feature Class**	**GM Feature Code description**
ILHA (**Island**)	04403	centroid	tbhd_ilha					BA030	f_code	FACC feature code	point	Island
				nm_nome_ocor (**island name**)	null	no information						
					actual value							
				cd_tipo_ilha (**island type**)	1	fluvial (**in river**)						
					2	maritime (**in sea**)						
					3	outras **(other**)						
					4	nao identificado (**unidentified**)						
								BH170	f_code	FACC feature code	point	Spring/Water-Hole
CONTORNO HD PERMANENTE LIM (**Permanent water body**)	04302	area boundary	tbhd_mas_agua					BH000	f_code	FACC feature code	face	Inland Water
				cd_fluxo (**water flow**)	3 or null	nao identificado	unknown	0	hyc	hydrological category		
					2	intermitente	non perennial /intermittent/ fluctuating	6				
					1	permanente	perennial/ permanent	8				
				nm_nome	null	no value	unknown	UNK	nam	name		
					actual value			actual value				
DELIMITADOR HD (**Closing line**)	04599	area boundary										
CONTORNO HD PERMANENTE (**Permanent water body**)	04402	area centroid										