

MAYARO RIO CLARO REGIONAL CORPORATION
RISK REDUCTION MANAGEMENT CENTRE
PILOT INITIATIVE

GIS TRAINING MANUAL



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Acknowledgements



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Preface

The Government of Trinidad and Tobago through the Office of Disaster Preparedness and Management (ODPM) is currently engaged in a pilot initiative along with four other countries in the Caribbean region to learn from, adapt and replicate the Cuban Risk Reduction Management Centre (RRMC) model, to our local country context. This model constitutes an instrument of local governments designed to manage (collect, document, compile, analyze, share) information about hazards, risks and vulnerabilities in a given territory and support informed decision-making by local authorities.

With financial and technical support being made available through project sponsors – UNDP and the Caribbean Risk Management Initiative (CRMI) and Cuban technical assistance, this country adapted RRMC pilot initiative which is aimed at improving the performance of local governance institutions - primarily the Disaster Management Unit (DMU) system in their disaster risk reduction responsibilities, while fostering increased level of community interface and participation. This initiative is also expected to supplement the capabilities of the National Disaster Office, thereby maximizing the effectiveness of disaster risk reduction and management (DRR/DRM) interventions all round.

Given the current DRR capacity gaps and constraints at the local level, the RRMC's main objectives will seek to improve and/or create better documentation, access to and transmission of critical disaster and emergency information within the disaster management system in Trinidad and Tobago. In view of this, the pilot RRMC implementation will focus on strengthening capacity within in the selected pilot site - Mayaro Rio Claro Regional Corporation (MRCRC), specifically in the areas of:

- a) Community-based Early Warning (EW) capacity and
- b) GIS technical capacity

These items represent critical gaps which have been lagging particularly at the local level as no consolidated programme for EW exists and community-based early warning systems are few or inefficient. In addition, risk management tools such as GIS are grossly under-utilized.

Introduction

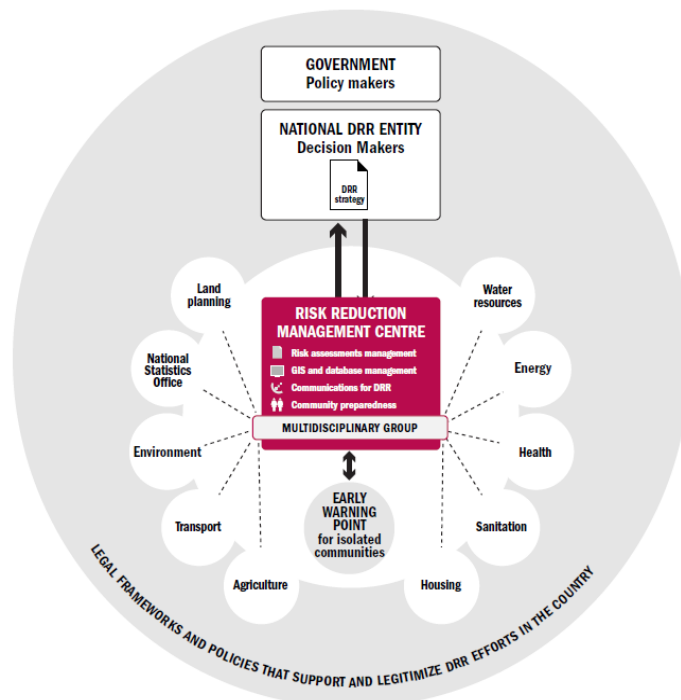
RRMC OVERVIEW

This introductory chapter seeks to define the Risk Reduction Management Centre (RRMC) and set out the clear Goals and Objectives for using GIS in support of RRMC operations. The information provided sets out guidelines for how the RRMC will typically operate.

WHAT IS THE RRMC?

- ▶ Initiated in the 2005, the Cuban model of Risk Reduction Management Centres (RRMC) has been identified as a best practice in the area of risk reduction. The RRMCs constitute an instrument of local governments designed to manage information about hazards, risks and vulnerabilities in a given territory
- ▶ **What is the Risk Reduction Management Centre (RRMC) Model?**

RRMC Components:



The Risk Reduction Management Centre model and its major elements

Main Functions of the Risk Reduction Management Centre Model

The Risk Reduction Management Centre plays the role of collecting, analyzing, compiling, and coordinating risk and disaster information for the purpose of informed decision-making by local authorities. Its primary functions are to:

- Facilitate analysis and periodic assessment of local risks and factors that produce vulnerabilities, with the participation of territorial institutions and organizations
- Control the reduction of vulnerabilities and risk when hazards occur
- Compile process and prepare information derived from surveillance and monitoring activities
- Participate in the preparation of territorial disaster reduction plans
- Document and preserve historic memory of disaster events and reduction actions
- Contribute to the promotion of a disaster reduction culture in the population, as well as influence their preparedness
- Participate in the response to and recovery from disaster situations

Broad Objectives

- ▶ Trinidad and Tobago, having qualified to benefit from the pilot replication of the RRMCS, will work to achieve the following broad objectives:
 - Build local capacity for risk assessment, analysis and management for the purpose of informed decision making at a local level and improved coordination with national level
 - Strengthen use of risk management tools such as hazard and risk studies, vulnerability assessments, GIS mapping, and database management
 - Strengthen community-based early warning systems and ensure they are connected with risk reduction mechanisms in the various regional corporations and country as a whole
 - Notably the above places deliberate focus on capacity building improvements at the local level. In its capacity as national coordinator of such disaster risk

reduction and management activities, the ODPM will be responsible for coordinating the local level actors as well as streamlining the aforementioned with national level Disaster Risk Reduction and Management (DRR/DRM) priorities.

Introduction to RRM GIS Component

Expected Output:

Capacity for use of GIS as a tool for collecting, managing and utilizing hazard, vulnerability and risk information is strengthened.

- Strengthen capacity and technical capability for using GIS technology at pilot site disaster management unit (DMU) – GIS to facilitate collection, management, analysis and transformation of hazard, vulnerability and risk information into vital output for decision making and support

GIS Component:

- Select personnel from the Mayaro Rio Claro Regional Corporation and staff of its Disaster Management Unit (DMU) will be the main beneficiaries of the GIS training. Provisions will be made to include at least 1 representative of neighboring DMUs and select persons who will be involved with the EWPS in training component
- Practical session will be incorporated in GIS training whereby, key datasets contributing to development of hazard/risk/vulnerability map of the MRCRC will be identified and preliminary collection of some of these data will be conducted. This will be supplemented by at least (2) further field mapping exercises during the implementation period. Intention that maps will be reflective of and/or seek to synergize with ongoing activities, projects and initiatives in the area - PVA results, IDB Country risk evaluation, developmental plans for the area e.g. Mayaro Rio Claro spatial development plan
- GIS implementation will take place at the MRCRC DMU office i.e. hardware, software, data, GIS trained staff will be housed at this location

MAIN OBJECTIVES OF GIS FOR THE RRM

GIS is a tool for planning and coordination, that facilitates decision-making in complex development processes. In terms of disaster risk reduction, the use of GIS in the RRM has

resulted in increased awareness among local authorities and the population in general about the dimension of risk to which they are exposed and what to do about the original causes.

The main objectives of the GIS are:

- Facilitate collection and analysis of DRM related datasets
- Establish appropriate databases
- Control different risk zones, for each type of disaster hazard identified
- Geographically reference the economic installations that might cause technological and public health disasters, as well as those that are at risk of being affected by them
- Geographically reference the different declared phases for protecting the population and economy, and evacuation plans for human and material resources
- Position and automatically plot hurricanes, in anticipation of their possible movements and locations of impact
- Surveillance and early alert of forest fires
- Establish bases for inserting these systems into the National Spatial Data Infrastructure of the Republic of Cuba (IDERC)

Common information needs of the Risk Reduction Management Centre (RRMC) include the following categories of data:

- Administrative boundaries – Regional Corporation, Communities, Electoral Districts
- Hazard, Risk and Vulnerability Data – Location of different hazard incidents, Main vulnerable areas – streets or communities, areas at risk to different types of hazards
- Critical Infrastructure (important for continuity of operations) – transport networks – roads, airports, ports, bridges, important government buildings, utilities
- Emergency resources – locations of firestations, police, medical, shelters, radio operators etc

Setting Expectations: Specific responsibilities of the MRCRC DMU/Local Government in terms of GIS

- Collection of hazard, vulnerability and risk related datasets for the MRCRC area (specific datasets may be identified e.g. collection of hazard incidents, streets highly vulnerable to flood etc, areas the pose industrial risk etc)
- Provide basic analysis of data collected for reporting purposes and to inform any necessary planning and mitigation works – to MRCRC Corporation, ODPM (e.g. many incidents tagged in an area over time, can be shown on a map to support decision to clean drains in area)

- Provide monthly report of geo-tagged incidents to ODPM and Local Government PS office. (These shall be forwarded to other relevant agencies – e.g. WRA, TCPD for their planning purposes)
- Ensure all GIS equipment is maintained and in good working order at all times. Responsibility for maintenance lies with the DMU

The approach is proposed to take staff of the DMU through a number of key stages and approaches to becoming familiar with and using GIS to support their everyday work

The Toolkit

The objective is to: Strengthen technical capability for using GIS technology at pilot site disaster management unit (DMU) – GIS to facilitate collection, management, analysis and transformation of hazard, vulnerability and risk information into vital output for decision making and support

This “**GIS Training Manual**” is a technical information package based on the findings of a pilot study in the Mayaro Rio Claro Regional Corporation, in south east Trinidad and Tobago to implement the Cuban model of risk reduction management centres.

The **toolkit** is intended to assist town planners, emergency managers, community leaders, and risk transfer providers in enhancing their disaster risk management capabilities as related to their respective areas of responsibility, specifically in the area of GIS. It is expected that this **Toolkit** will make a significant contribution to the understanding and practice of disaster risk management in the Region.

CHAPTER 1

Understanding GIS

This GIS overview is intended to be a general introductory section to familiarize users with the basic GIS knowledge, concepts and examples. The information in this chapter will be made more specific to the Risk Reduction Management Centre (RRMC) /Disaster Management unit (DMU) operations in later sections i.e. Users should be able build on and apply the information learnt here, to the RRMC GIS Operations section, which details the typical and even daily RRMC GIS operations and standard operating procedures.

AT THE END OF THIS CHAPTER YOU BE ABLE TO ANSWER THE FOLLOWING QUESTIONS

- What is GIS?
- What are the main components of a GIS?
- What are typical GIS functions? I.e. what can GIS do?
- Data types and what makes data spatial?
- What is the word used for defining “data about data”?
- What are some real world applications of GIS?
- What is your GIS project goal?

What is GIS?

These are some formal definitions of a GIS-

“A geographic information system (GIS) is an organized integration of hardware, software and geographic data designed to capture, store, edit, analyze, share and display geographically referenced information. It is used to resolve complex problems of planning and management. In a more general sense, the GIS is a tool that allows its users to perform interactive requests, analyze spatial information, revise data and maps, and present results of these operations”
Cuba Risk Reduction Management Centres, Best Practices in Risk Reduction, 2010

“A system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data which are spatially referenced to the Earth. This is normally considered to involve a spatially referenced computer database and appropriate applications software”. Chorley Report, 1987

Why is GIS unique?

Geography is information about the earth’s surface and the objects found on it, e.g. people, trees, buildings, roads, shoreline etc. GIS then provides a system for organizing this knowledge. GIS helps manage, analyze, and distribute geographic knowledge.

What distinguishes GIS from other information systems?

- GIS integrates spatial and other kinds of information within one system: it offers a consistent framework for analyzing space
- GIS makes connections between activities based on spatial proximity
- GIS provides the mechanisms for undertaking the manipulation and display of geographic knowledge

GIS Foundation

This section is intended to introduce users to the foundation aspects or main components of a GIS. Each of the components will now be examined in further detail.

GIS Components

A working GIS integrates these five key components: hardware, software, data, people, and methods/applications (Figure2).



FIGURE 1 – GIS COMPONENTS

Hardware

The hardware in the form of the computer is central in this area; it runs the software, this is where data collected is stored and where the personnel interact with the data. However, hardware isn't static. It obviously depends on what your goal is. If the project requires a report of all landslides in a Mayaro for a specific time period, scuba gear isn't going to be useful; in coral monitoring exercise it is. In this respect some of the hardware needed is variable but essential to the process.

Devices can be categorized in four general ways:

- Data collection: GPS, Cameras, Probes
- Data Input: Scanners, digitizers
- Data Output: Printers, Computer monitors, plotters
- Data analysis and storage: Computers, hard drives

Software

GIS software provides the functions and tools needed to store, analyze, and display geographic information. Key software components are

- A database (management system)
- Tools for the input and manipulation of geographic information
- Tools that support geographic query, analysis, and visualization
- A graphical user interface (GUI) for easy access to tools

A well rounded GIS package has tools to support both vector and raster analysis. Over time you may develop preferences depending on the type of analysis being done. The main GIS software is often referred to as a desktop GIS package since GIS software is a large collection of tools which is key to the entire system.

Capture > Input > Analysis > Output

There are free (open Source) GIS packages as well as proprietary ones, several of which can be run not only on Windows but on Linux and Mac OS X. While free GIS packages are useful, it is important to remember that as GIS integration in your organization grows, investing in software will also be necessary. Well known commercial applications are known to be more robust in their software functionality but also tend to be very stable. Also because of the market-share that they command, the vendors often provide technical support for their products and occasional training programs.

People

People design, sell and use GIS applications. Without people, there is no GIS. GIS technology is of limited value without the people who manage the system and to develop plans for applying it. GIS users range from technicians to specialists, who design and maintain the system to those who use it to help them do their everyday work.

Methods

Methods are well designed plans and/or business rules describing how the technology is or should be applied. This includes:

- Guidelines
- Specifications
- Standards and
- Procedures

Data

Data fuels a GIS and is the most important component of a GIS. Geographic data and related tabular or attribute data can be collected in-house or bought from a commercial data provider. Most GISs create and maintain a database to help organize and manage data.

What makes data spatial?

Spatial data simply has to do with geographical representation of an entity or feature on earth's surface i.e. it refers to information that is associated with a location or place (Figure 3). Spatial data has particular characteristics that can be described in terms of: shape, place and relationship to other spatial data. It may be recorded on a map, held as records in a database or even be represented as a photograph. Remember that Geography is, in fact, the study of spatial information and we are surrounded by geography. You will also discover that most information is either spatial or has a spatial component.

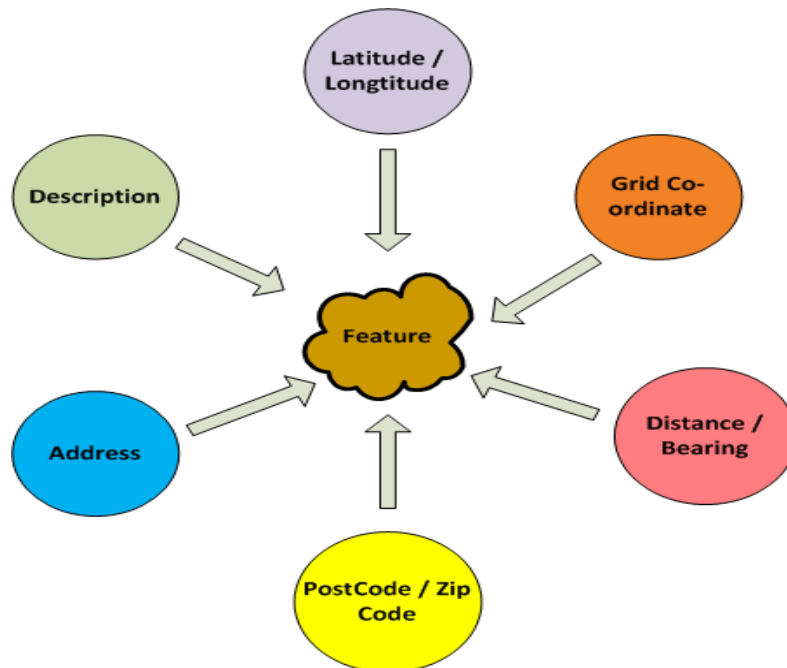


FIGURE 3 – SPATIAL DATA

Tabular and attribute data are non-spatial but can be linked to location data – in fact an important aspect of spatial data is that it often contains *attribute* information. That implies that a description of the feature (e.g. road) is held in some form. The description might be the name or the type of road (A, Secondary, Highway, 3rd class). This information might be held in a database record or simply written or depicted on a map. The following is another example:

Shelters dataset – shelters are a spatial feature and the associated information about the shelter - name, Address, capacity etc are non-spatial attributes linked to the shelter by its location.

Spatial / Geographic data: Shelter location – x coordinate, y coordinate

Non-Spatial Tabular or Attribute data: Shelter name, Address, Capacity etc

At this juncture it is important to remember what you put into the GIS – i.e. the specific geographic and tabular/attribute data is what you get out, so make efforts to plan any data collection, with your outputs or end products in mind.

Data Types

Data Values

1. Nominal – just gives a name, an identifier. No computational information but useful in distinguishing different values.
2. Ordinal – this assigns rank to events or objects. It is a natural order for example first, second, third or ranking household income as “high”, “average” or “low”.
3. Interval – incremental; no multiplying or division but you can express ratios or differences, for example, age.
4. Ratio – length or area

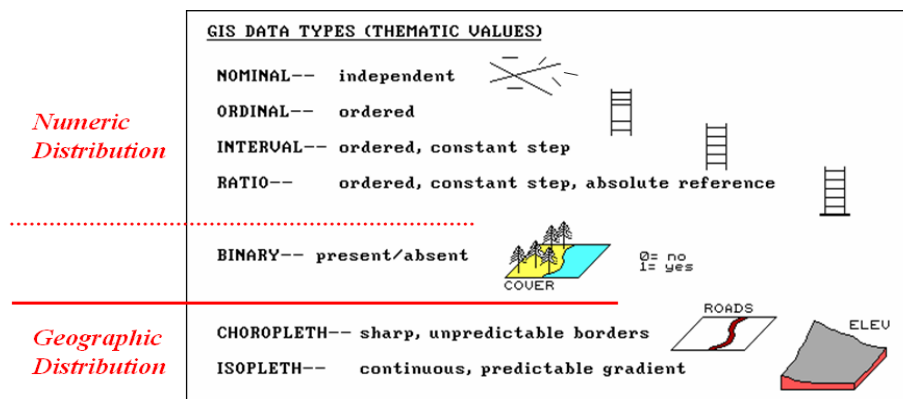
Geographic Data Types

1. Spatial Map Data – this is the location and shape of an event or feature.
2. Attribute Data – This is Descriptive data. It identifies what the map data is. These are all considered non-spatial because by themselves they do not pinpoint a location. It can be qualitative (nominal data) or quantitative (ordinal, interval or ratio data)
3. Image Data – satellite image, aerial photographs and scanned maps fall into this category

FIGURE 4

Numeric and Geographic Data Types

...all digital maps are composed of organized sets of numbers– the data type determines what “map-ematical” processing can be done with the numbers on a map, or stack of map layers



Data Models

Vector Data – (geo-objects) features are represented as Points, Lines, Polygons - Figure 5 (3)

Raster Data – Store features on a grid or as pixels – Figure 5 (2)

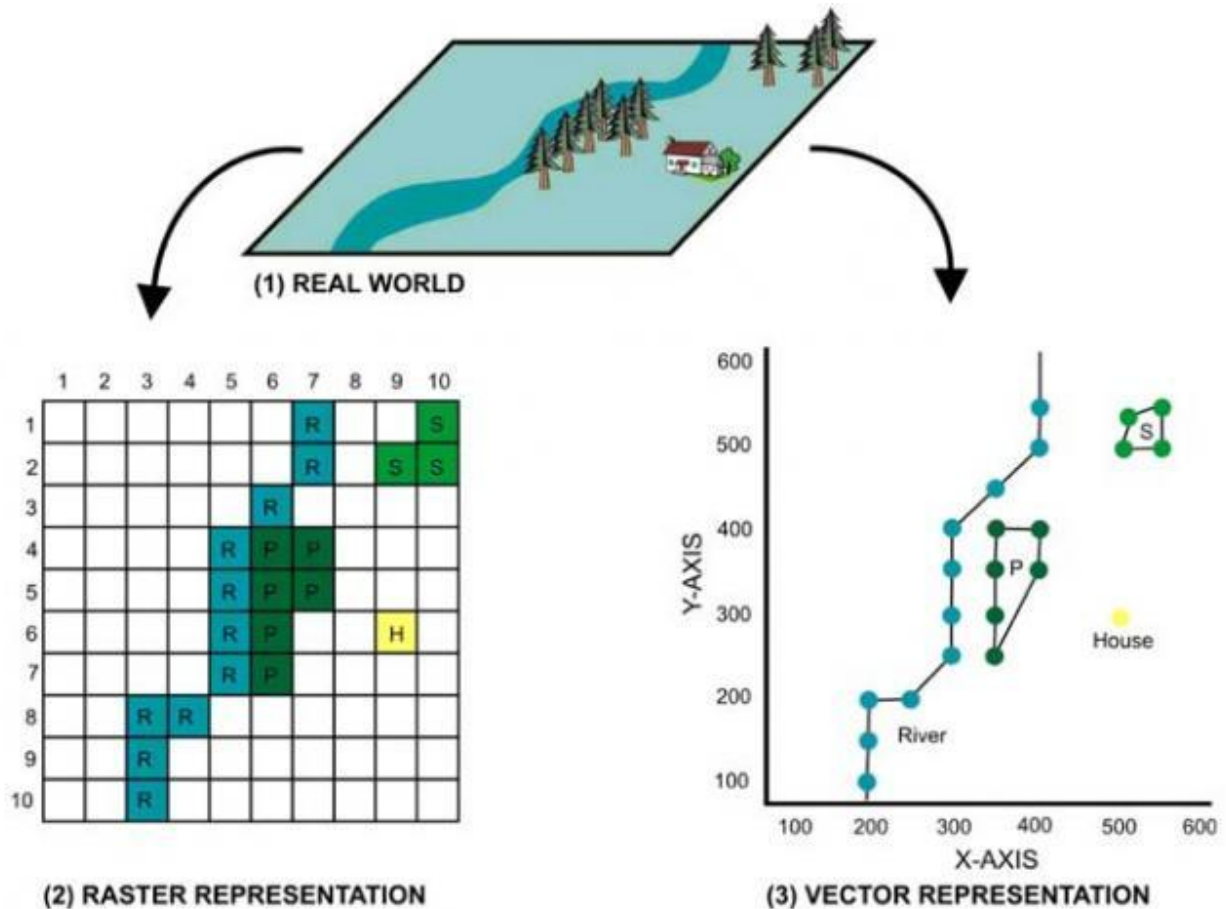


FIGURE 5 – (1) REAL WORLD, (2) RASTER REPRESENTATION, (3) VECTOR REPRESENTATION

Models are ways of storing geographic information in the GIS. By using data models we can represent the real world in a way that the computer can understand and do analysis that hold true to the real world. The two most common data models are Vector and Raster.

Vector Data (Database oriented)

- Represents the world using points, lines and polygons, these are useful for storing data and representations of features such as buildings, trails and roads. The data is discrete. Examples of vector data models are Shapefiles (Esri), Triangulated Irregular Networks (TINs) and AutoCAD (.dxf files).
- Points are non dimensional defined by x , y coordinates.
- Polygons are the enclosure of one or more lines

- Points and elevation = Line e.g. pole
- Lines and elevation = A vertical polygon e.g. a wall
- Polygon and elevation = A 3 dimensional feature e.g. volume

Vectors are more database oriented and are very good at representing features such as rivers, boundaries and roads.

Advantages

- Compact data structure
- Suitable for cases where data must closely represent hand drawn maps
- Have an accurate advantage
- Good for storing data that need topological information – they can store information of how a feature connects to others e.g. road networks
- Good system for plotting data

Disadvantages

- Complex data structure
- Overlaying data is not simple
- It doesn't represent data over surfaces well e.g. topography

Sources – GPS Surveys, manual digitizing

Raster Data (Analysis oriented)

- This model uses grids to store map data. It creates a continuous surface defined by series of discrete grid cells. Each cell has a value that represents attribute data at that location.
- Cell size determines resolution. The smaller the cell size the better the resolution. For example a 50 meter Landsat image means that each cell is 50 meters on the ground. A smaller cell size means more details.
- Raster grids can analyze and retrieve data quickly. This is because the raster structure closely resembles that of a computer's.
- The data is a continuous representation of a study area and is therefore suited to data that is continuous such as terrain, vegetation and natural resources. With raster data you can create atmosphere models, density models and remotely sensed data.

- This system is data intensive as it must record data at every cell whether it is needed or not.

Advantages

- Overlaying easily done
- Variability is well represented
- Easy to understand

Disadvantages

- Not a compact data structure
- Connective relationships are difficult to represent
- Blocky appearance

Sources – User interpolation of vector data, commercially available

Metadata

'..the who, what, when, where, how and why of the dataset'

Often referred to as “data about data”, metadata is a summary description of the data set it is included with. This includes notes on the content, quality, type, creation, condition, origin/ source organizations, data format, accuracy and spatial information about the dataset. It can be stored in any format such as database files or text format. Esri has further described it as information about existing data that becomes readily available to anyone seeking it. Metadata makes data discovery easier, reduces data duplication and assists users with more informed use of a specific dataset.

Importance

Metadata makes data more useful to users by making it easier to document and locate data sets and also allows users to interpret and use data properly, as well as the reliability and currency of data. The growing availability of data, different sources has helped GIS technology become more useful and widely available. As such it is important to know whether the data you just have bought or downloaded is useful to you.

Metadata Answers

This is a checklist as to what to include when creating metadata for a dataset

- ✓ Who collected the data?
- ✓ Who owns the data?
- ✓ What is the subject or theme of the dataset? E.g. Rivers dataset
- ✓ Projection of the data?
- ✓ When was the data collected? (How old is the dataset? currency of dataset)
- ✓ Where was the data collected?
- ✓ Why was the data collected? (What was the purpose/ rationale for collecting? E.g. specific project)
- ✓ How was the data collected?
- ✓ How should it be used?
- ✓ What are the use restrictions?
- ✓ How much does it cost?

Metadata Management

Both data and time are costly. A GIS development plan that takes metadata into account from the beginning will save time and money later. Data expense continues to be the largest part of most GIS budgets, usually more than staff costs. If metadata is part of standard operating procedures, creating metadata costs virtually nothing. Time and effort related to metadata should be entered into the budget or project plan of every GIS operation.

Database Management: Any system needs guidelines and procedure.

Resources: GIS takes needs to purchase equipment and data. Although the starting up cost for a GIS is often very expensive, it is much easier for small organisms to adapt to the changes and minimize costs.

GIS Functions (What can GIS Do?)

The 5Ms of GIS

- Mapping
- Measurement
- Monitoring
- Modelling
- Management

Mapping & measurement

- Where are we?
- How far is the nearest hospital from the site of the accident?

- What is the size of Arima Borough Corporation?

Monitoring

- What would happen if . . .
A chemical leaked into a Caroni river?
- Where does . . .
Flooding occur most in Trinidad?
- Has . . .
Population changed over the last ten years?
- Is there a spatial pattern related to . . .
Volume rainfall and location of landslide

Modelling

- Simplified representation of a phenomenon or system
- Utilizes a set a of transformation tools that derive new geographic datasets from existing datasets
- Geo-processing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets.

General purpose GISs essentially performs six processes or tasks.

- Input
- Manipulation
- Management
- Query
- Analysis
- Visualization

To be of any value, a GIS must perform a wide range of data manipulation and analysis functions. Thus all *good* GIS systems should be able to answer the types of questions listed above. The only limitations would be the availability of data and the functions of the specific software package

GIS function in an organization is defined by the goals and needs in that organization. There may be projects where little to no analysis is needed but data capture and presentation is

important. For example, the mapping the location of hazards and their impacts to share with government officials for future preparedness and mitigation planning.

In any project situation having a clear outline of each project's goal, particularly when it comes to expected GIS output, is important.

Data Capture

Data is derived from primary and secondary sources

Primary data sources include: field data collection, data collected with GPS etc

Secondary data sources include: Other agencies, data from reports etc

Information gathering also involves collection of field data, GPS data and satellite imagery.

When starting a GIS, most often the data inputted relies mainly on the field and GPS data captured by the organization.

What kind of work do you do? What are your main work functions? What are the data relevant to your organization?

What do you want to do? applications e.g. hazard mapping

What kind of data do you need? – hazard locations, what is being impacted, what could be impacted, at risk? etc

Data Management and Storage

After the data is entered into the system it needs to be verified and integrated in a suitable way for storage and retrieval. It also includes ensuring that the data is updated.

Analysis

GIS provides a way to use data from many sources. It also supplies the tools necessary to compare and analyze different formats of information. The interdisciplinary nature of GIS has made it possible to input data from various fields of study such as engineering, water resources, oil and gas, economics, business enterprise, agriculture and hazards in our own field (disaster risk management) analysis. This is a distinctive feature of GIS. This process essentially tries to derive data from existing data. Here we try to find relationships between the features and patterns in the spatial data. Some of the functions involved in this included interpolation (trying to predict missing values from a set of given values), buffering (calculating distance functions from geographic features) and overlay operations. These functions can be essentially defined into several categories (Figure 6).

These are

- Retrieval classification and Measurement
- Overlay

- Neighborhood functions
- Connectivity functions

Retrieval Classification and Measurement

- Selective search and manipulation of data
- Classification based on attribute data values

Overlay

- Combines data sets to create new ones. Can be done with both vector and raster data.
- Combining two data layers and performing operations such as intersection, union or difference

Neighborhood functions

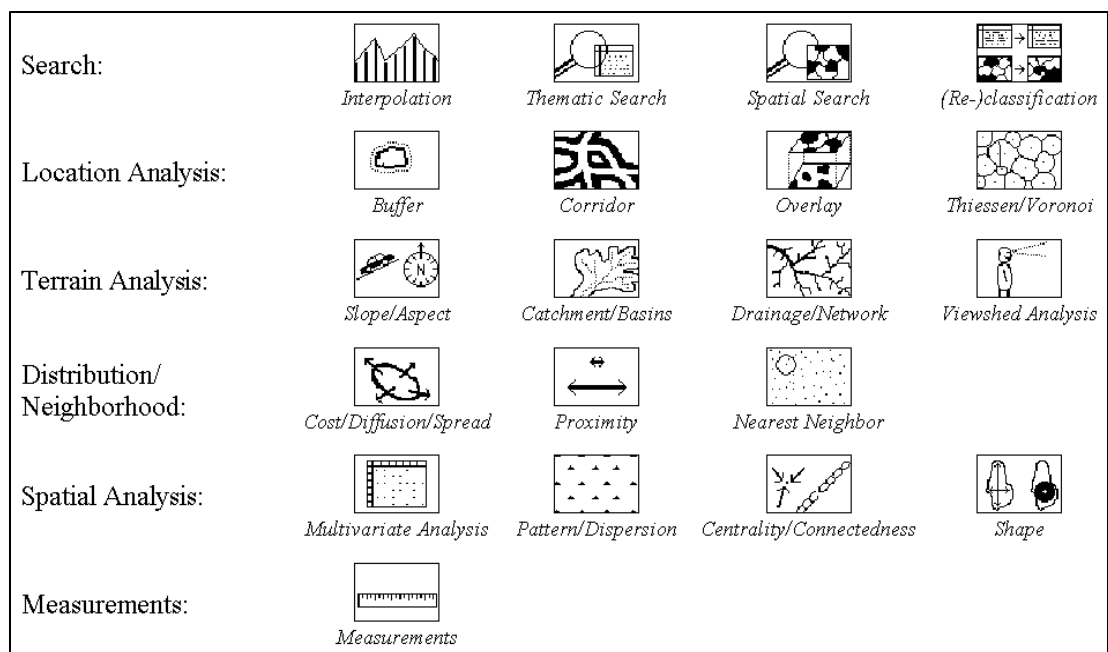
- Search functions within a given area
- Proximity functions – measuring distance from points, lines and polygons
- Contour generations

Connectivity functions

Network analysis

- Best path analysis - useful in situations where moving or delivering resources is important
- Shortest distance paths
- Least cost path
- Viewshed analysis

FIGURE 6 –
GIS ANALYSIS
FUNCTIONS



Questions you can ask using these functions

Where?

Location Queries

Where are the communities that have been impacted by floods?

Where is the nearest shelter with a population of over 4000?

What is?

Conditions Queries

Which villages are traversed by rivers?

What town has the largest population of special needs persons?

How has it changed?

Trend analysis

For the last 5 years, which months of the year have highest frequency of hazard incidents occurring?

What type of hazard is most frequent in the dry season/ in the rainy season?

Is there is pattern?

Pattern analysis

Where has consistently been impacted by floods (or other types of hazard)?

What if?

Modeling

What coastal areas would be inundated if a 15 ft tidal wave hit the eastern side of the island?

Where are the best areas to site a shelter or early warning point?

Presentation and Output

GIS is a move away from the traditional ways of just tabular and graph data. It maps spatial data, lists and reports, the attribute data. Map making particularly relies heavily on some knowledge.

GIS in the Decision Making Process

The key to establishing this type of technology within an information framework for the purposes of decision making is INTEGRATION: the linking together of technology, data and a decision making strategy (Figure 7).

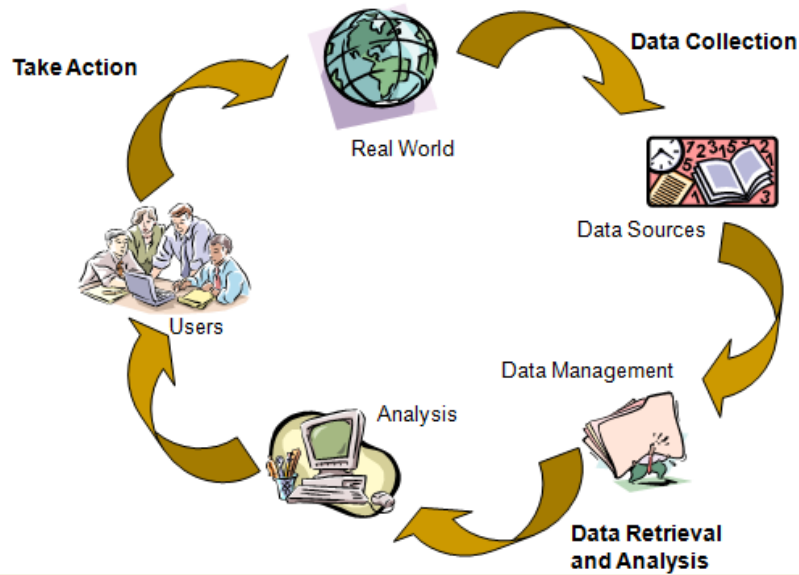


FIGURE 7 – GIS IN THE DECISION MAKING PROCESS

Key Points:

- ✓ GIS Functions: Determine how GIS will be used in your organization; how will you apply GIS – to solve what problem? This will set the tone for what you need to get or put in place – what kind of data, software, hardware etc

- ✓ Hardware: Hardware is an essential component of a GIS. Choose hardware that is appropriate to the identified needs of the organization

Chapter 2

GPS

Knowing where things are an important component of any GIS; in fact, without it, a GIS would be no different from any other database. Because GIS is slowly growing in popularity in the Caribbean, any system started would rely heavily, and in some cases entirely on field data. Understanding this, a GPS receiver now becomes a critical part of the system.

At the End of this Chapter you should be able to answer

- What is a GPS?
- How does it work?
- How many Satellites orbit the earth at any given time?
- When was the First GPS invented?
- What disciplines utilize GPSs?
- How can it help you at the DMU?

The Global Positioning System is a radio navigation system developed by the US Department of Defense. The entire system is commonly divided into three parts, the space segment, the control segment and the user segment.

A constellation of 24 – 32 satellites are in geosynchronous orbit around the earth, at least 24 are operational at any time (Figure 8). All transmit a one way signal enabling users to locate their position on earth. This is the space segment.



FIGURE 8 Constellation of GPS satellites and their orbits. (McNamara, 2004)

The US Department of Defense uses 5 ground control stations to send corrections to the satellites where necessary (Figure 9). They are located in Hawaii, Colorado Springs (master station), Diego Garcia, Kwajalein and Ascension Island. Satellites pass over these stations once every 12 hours where they receive corrections. The ground control stations time is always correct. This is critical because all calculations originate from the satellites and time is a critical part of the process. This is the control segment.

GPS Control Segment Stations



FIGURE 9

The satellites constantly give a three dimensional positioning that anyone with the appropriate equipment has access to. This is the user segment (Figure 10).

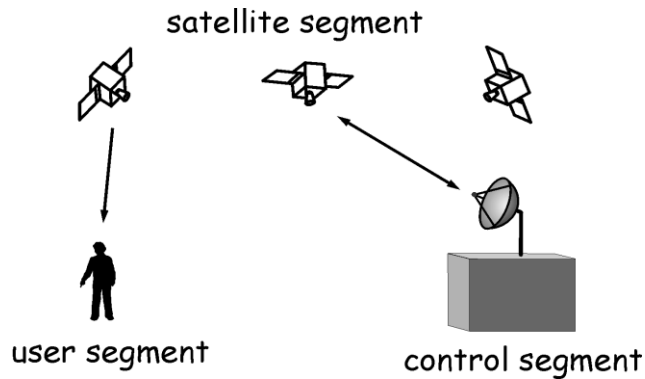


FIGURE 10 – GPS COMPONENT

Your position on earth is determined by measuring your distance from the group of satellites. The GPS receiver measures the time it takes for a radio signal to reach to it from the satellites, this depends on an accurate clock.

The time is then converted to a distance and through triangulation, your position is calculated. Once there is time and velocity, distance can be calculated. The GPS receiver needs at least 3 – 4 signals from satellites to derive a position.

There are always 4 satellites overhead at any one time (Figure 11). The satellites require a line of sight with the receivers to pinpoint location; this is why you generally don't get good signal indoors or under thick canopies.

All satellites have the same time and they always know exact position.

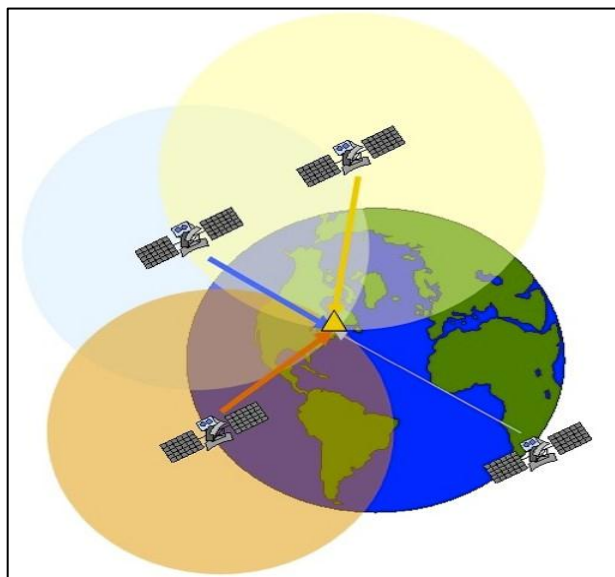


FIGURE 11 – SATELLITE POSITION

GPS Errors can arise from

1. Number of satellites in the sky and the arrangement of them
2. Multi-path Errors: this occurs when radio signals bounce off terrestrial objects such as buildings or natural phenomenon, for example mountains, before reaching the receiver.
3. Atmospheric interference
4. Satellite drift: Occasionally the satellites drift slightly off course. The satellites have 4 very precise atomic clocks and a microprocessor for limited data analysis of self monitoring. The ground control stations play an important part here by sending corrections to the satellites where necessary as they pass over the ground control stations.
5. Receiver clock errors: A receiver's built-in clock is not as accurate as the atomic clocks onboard the GPS satellites. Therefore, it may have very slight timing errors

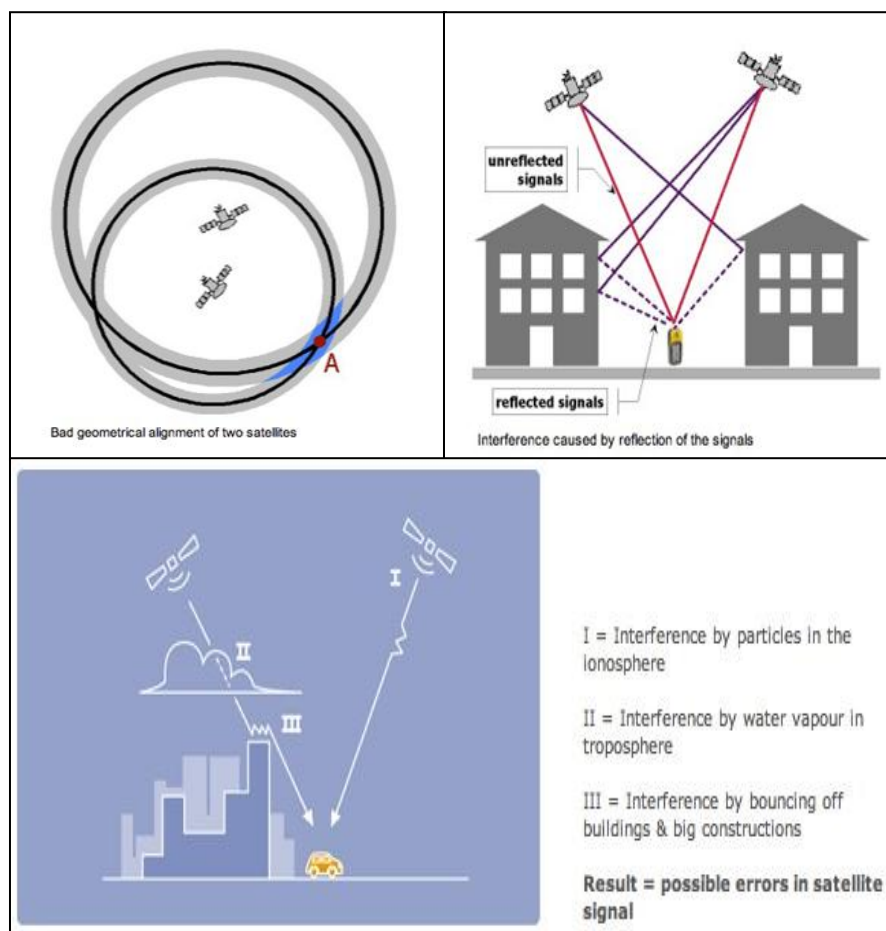


FIGURE 12 – GPS ERRORS

Key Facts

- Satellites are 12600 miles above the earth
- Moving at 8653 miles per hour
- They circulate the earth once every 12 hours

As the GPS has to be incorporated into the workflow at your DMU to gather data; such as collecting points of hazards such as landslides, a flooded house or fallen tree location, having a checklist is important and marking an “x” or a “✓” next to an item. Ensure these are done before going out in the field to collect data.

ITEM	STATUS
Check that you have extra batteries	
Check receiver settings and coordinates are in the right datum and projection	
When collecting the data, it is important to be centered as much as possible and within a relatively open space in order to pick up clear satellite signals	
Check that the unit has locked into at least three satellites before recording your position	
To mark a point, wait at least one minute before recording your position or mark your position three times to ensure accuracy	
Always have a backup plan, and have a spot to include the point number and coordinates written on the field survey form (Chapter 6)	

This check list can be amended as the need arises. A data form can also accompany the field assessment form or inclusive of it (Figure 13).

Chapter 3

MAP DESIGN

A map is a representation of the environment that is presented graphically. As a representation, it stands for the environment, portrays it, and is both a likeness and a simplified model of it. Maps are so intuitive and serve so many purposes that it's easy to forget they're one of our most sophisticated conceptual creations. They tell us as much about how people think and communicate as they do about the environment mapped. But, ultimately, a map is meant to reveal something meaningful, interesting, or useful by manipulating and displaying the results of data processed to expose essential characteristics about the geographic features, attributes, and phenomena they represent.

At the End of this Chapter you should be able to answer

- What are the Key elements in a map?
- What are the 6 Commandments of Map design?

The Map Scale determines the spatial resolution of the graphic feature representation. The smaller the scale, the less detail a map can show.

Once you're creating a map, one must ensure the map

- Map meets the intended purpose
- Satisfy your needs
- Is easy to understand
- Is accurate, and
- Presentation is the key

Likewise all Maps should have these basic elements (e.g Figure 14)

- **Title**
- **Scale**
- **Legend**
- **Author**
- **Date**
- **Overview Map**

Title

What is the map showing? Where?

Schools in Mayaro

Scale

Map scale is an expression of the relationship between the size of what is on a map and the actual size. So the larger the number the smaller the scale thus more details. By understanding this, you can quickly determine what scale you need for any map.

Legend

This explains all the symbols used in the map. It should be clear and easily understandable. Where possible and or necessary the symbol size should be the same size as they are on the map.

Author

The person or organization that created the map. If data was sourced elsewhere this should also be included here.

<Organization>

<Organization Address>

<Email Address>

<Phone Numbers>

Date

This should state when the data was created or when the map was created.

Overview Map

This gives any viewer an idea as to where in an island or country they are looking at.

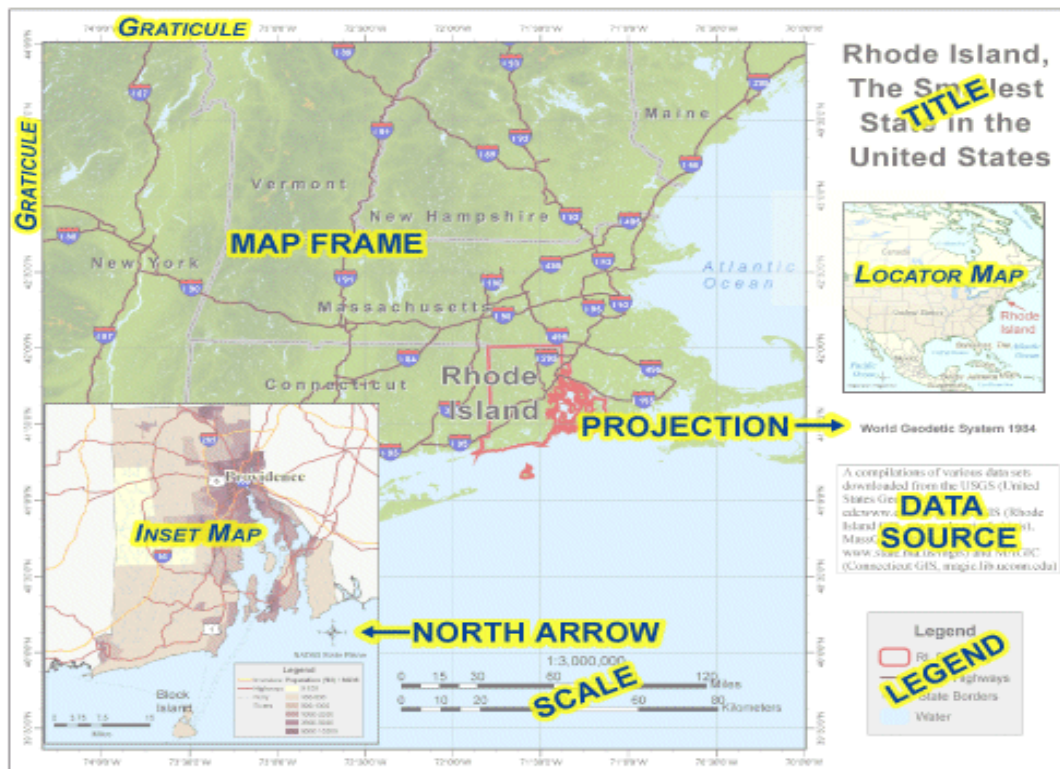


FIGURE 14 – BASIC MAP ELEMENTS

6 Commandments for Map Design (Figure 15)

Commandment 1

Map Substantial Information

The map should show interesting relevant data and it should be clear.

Commandment 2

Don't lie with Maps

Don't use data out of context. Map should only represent what the data says.

Commandment 3

Effectively Label Maps

Labels should be clear and detailed.

Commandment 4

Minimize Map Crap

Oversized elements (North Arrow and scale), in appropriate fonts, extraneous borders and unnecessary 3D effects take away from the map more often than aiding in the aesthetics of it.

Commandment 5

Map Layout Matters

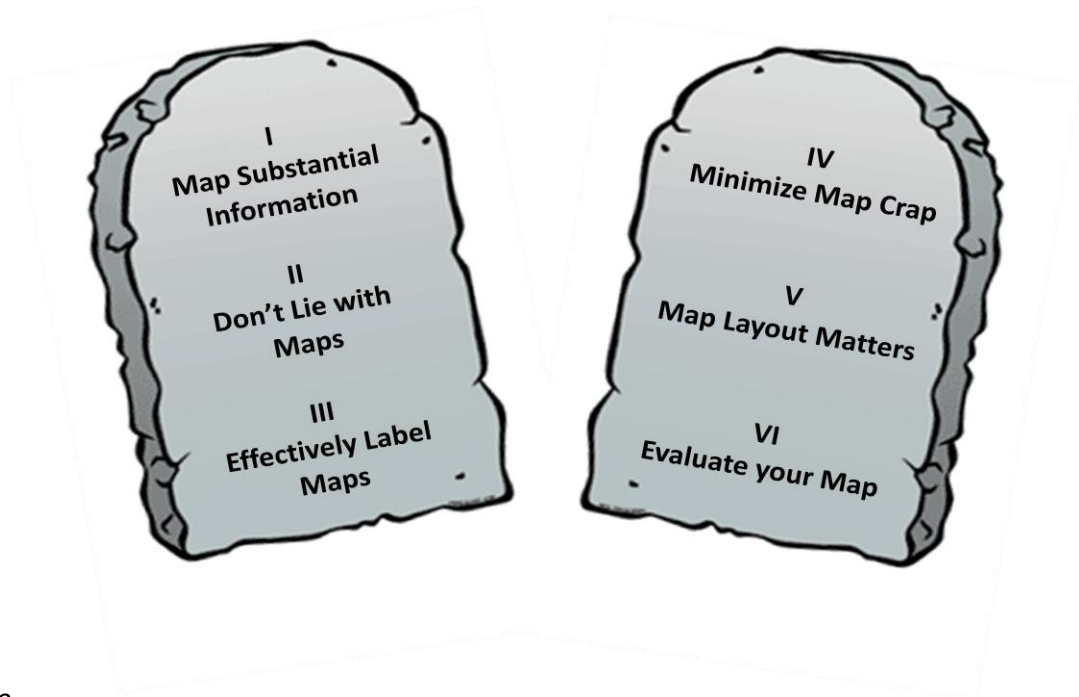
Layout strongly affects the look and feel of the map, and can make a map easy or difficult to read and interpret.

Commandment 6

Evaluate your map

This should be constant throughout the mapmaking process. At the end, evaluate whether the map achieves the initial goal.

FIGURE 15
COMMANDMENTS
OF
MAP DESIGN



Things to note

- Contrast: Lines, textures and colour help to create this.
- Text Contrast: Important things should look important but not over power the map.
- Map Lettering: Should be functional first and decoratively second. Where text is placed is key to giving a clean look to the map. Letters and words should be legible.
- Colours: Balance colours used.

CHAPTER 4

GIS Applications

GIS Application Software encompasses a broad range of applications which involve the use of a combination of digital maps and georeferenced data. And likewise, it includes the use of both free open source software and the commercial GIS packages. As an organization, one must take into consideration the availability of finances before selecting an application

At the end of this chapter you should know

- Know who offers open source GIS applications and their applications
- What types of commercial GIS packages are there

Free Open Source Software

Windows, Mac OS X, GNU / Linx

Grass – Geographic Resources Analysis Support System

<http://grass.osgeo.org/>

Raster, topological vector, imagine processing, 2D / 3D vector engine with vector network analysis and graphics production functionality that operate on various platforms through shell and a graphical user interface.



QGIS – Quantum GIS

<http://qgis.org/>

User friendly Geographic Information System. QGIS supports vector, raster and database formats. It support many common spatial data formats. QGIS support plugins to display tracks from GPS.



uDIG

<http://udig.refractions.net/>

uDig is a spatial data viewer and editor



Earth3D

<http://www.earth3d.org/>

Earth3D is a program to display the earth as a 3D globe (including height, fields) in real time.



Minerva

<http://www.minerva-gis.org>

This software unifies standard GIS capabilities with high performance, 3D visualization. Minerva's primary strength is the ability to display raster and vector data together from multiple sources at interactive speeds. It can easily display large terrain and image repositories because it automatically draws the appropriate level of detail.



Minerva

Home

ArcExplorer

<http://www.esri.com/software/arcexplorer/index.html>

ArcExplorer is a freely available lightweight GIS data viewer that lets you perform a variety of basic GIS functions. With ArcExplorer, you can display, query, and retrieve data. It can be used as a standalone application with local datasets or as a client for Internet data.



Windows only

Map Maker Gratis

[http:// www.mapmaker.com/](http://www.mapmaker.com/)

It is used in a wide range of environmental work including forestry and fisheries. It supports raster and vector data and can import and export a wide range of formats including ArcView shape files and MapInfo files.



DIVA-GIS

<http://research.cip.cgiar.org/confluence/display/divagis/Home>

It is a free geographic information system software. DIVA-GIS was specifically developed for use with biological distribution data such as available from natural history museums and gene banks. With DIVA-GIS you can:

- i. Map the locations of sites where populations of plant or animal species were observed, and of different characters that may have been recorded for these populations



- ii. Make grid maps of the distribution of biological diversity and identify “hotspots” and areas that have complementary levels of diversity, and
- iii. Extract climate data for localized points, and predict the presence of species based on climate.

gvSIG

<http://www.gvsig.gva.es/eng/inicio-gvsig/>

works on Linux as well

gvSIG is a tool oriented to managing geographic information. It is characterized by a user friendly interface, with a quick access to the usual raster and vector formats. It is aimed at users of geographic information, whether professionals or civil servants (city councils, regional cooperations, ministries) from any part of the world.



And don't forget.....

DNR Garmin

<http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html>

This free software can be used to download data off your gps unit and also convert its data into different formats for use in other applications based on the file type required, e.g. ArcGIS shapefile (.shp) into Google Earth files (.kml or .kmz).



Google Earth

<http://www.google.com/earth/index.html>

Here not only mapping can be done but you can enjoy the world in 3D, fly to options and other planets.



Commercial GIS Packages

ArcGIS

<http://www.esri.com/>



MapInfo

<http://pbinsight.com>



Intergraph

<http://www.intergraph.com/>



Manifold System

<http://www.maifold.net>



Global Mapper

<http://globalmapper.com>

Global Mapper Software, LLC

TNTmips

<http://www.micromages.com/>

(Free limited version available)



Now, which best suits your organization?

CHAPTER 5

GIS in Disaster Risk Reduction and Management

GIS is an essential technology for all phases of disaster management – preparation, mitigation, response and recovery. To prepare for and mitigate disasters, GIS can map and model potential disasters to help visualize vulnerabilities and damage consequences. As rebuilding begins, GIS aids local, state and other agencies with technology that supports collaboration between multiple agencies.

Field data captured with a mobile device provides the ability to add updates from remote locations for more efficient incident management. It also supplies rapid damage assessment and more accurate recovery operations.

Individuals and organizations responsible for emergency management use many tools to save lives, reduce human suffering and preserve economic assets before, during and after a catastrophic event. Correct and timely information is a critical part of any successful disaster management program and GIS can provide that sort of information.

GIS increasingly has been incorporated into disaster management and can be part of the solution to many emergency management problems.

At the end of this chapter you should know

- How GIS can provide support in Disaster Management
- The Core Capabilities of GIS in Disaster Management and Risk Reduction
- How GIS is used locally at local Disaster Management Agencies

GIS can provide a System for Disaster Management

This system supports all facets for disaster management which includes preparedness, mitigation, response and recovery (Figure 16).

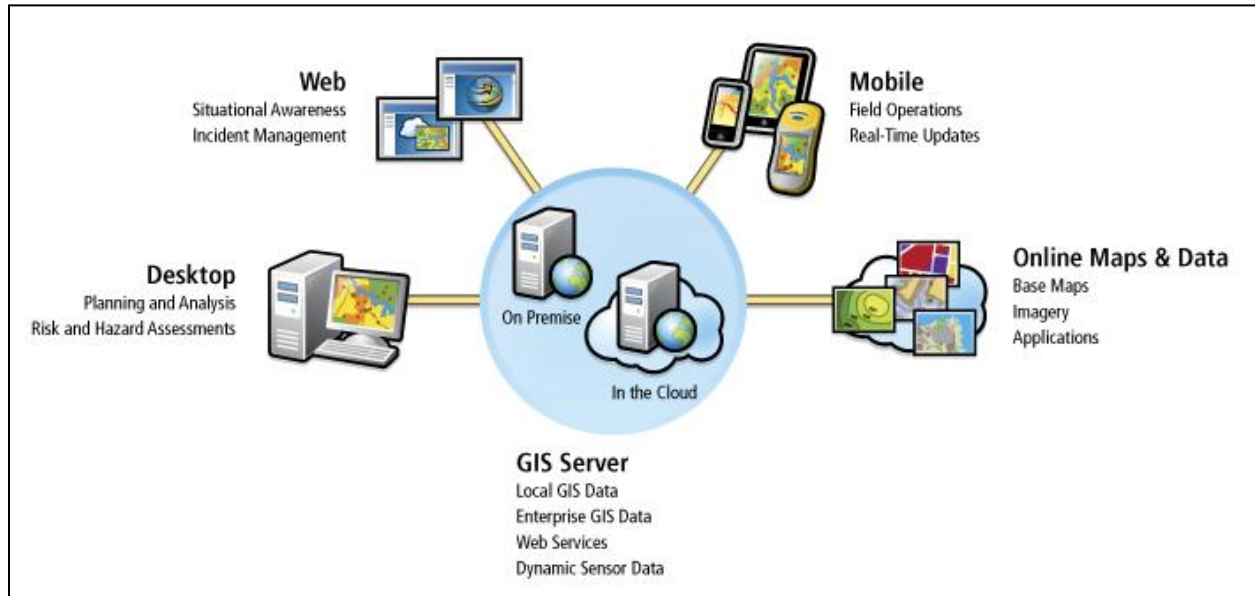


FIGURE 16 – GIS FOR DISASTER MANAGEMENT

Desktop

GIS spatial analysis and modeling power provide the tools necessary to perform a thorough risk and hazard assessment. Not only can GIS quickly map and display critical infrastructure, populations, and other community values exposed to natural and technological hazards, it can also model potential events to determine consequence and loss.

Web

A web-based GIS enabled common operating picture (COP) provides an essential geographic context of the jurisdiction with base layers of information (imagery, streets, critical infrastructure, elevations, etc.) GIS can also consume and publish dynamic GIS data and services from other systems (weather, traffic cameras, video, GPS, 911 calls, etc.). Operational analytics (demographic analysis, plume modeling, road closures, etc) on the GIS platform can be performed by fusing base map data with dynamic data.

Mobile

Mobile GIS technology now provides the capability to support a number of jobs within the disaster management workflow. These capabilities include providing access in the field, the

ability to provide updates to this data from the field in tactical and administrative operations, and the ability to collect all types of GIS and non GIS data that can be transmitted to the EOC or Management Unit for visualization within a geographic context.

Online Maps and Data

Online Maps and Data provide access to all types of GIS data, imagery, and applications which is a key component for disaster management. A variety of worldwide base maps are available including imagery, streets, topography, community base maps and more. Disaster Management personnel can create private or public groups to exchange map data, projects, and presentations.

GIS Server

A GIS Server is the core component of the GIS system for disaster management depending on the size of the unit using it. However, it can be deployed within the disaster management facility or can be hosted in the cloud and provided as a GIS service. The Server can provide a platform for the organization and management of GIS data available to the desktop for planning and analysis for enhanced decision support and analysis of unfolding events. It manages mobile connections to consume updates and edits which are stored in the database. It also enables access to dynamic data, services, and other online GIS data that is made available to all other GIS clients and viewers within the system.

Usefulness of GIS in Disaster Management

The following are the core capabilities that can be enhanced using GIS technology enabling staff to more effectively carry out all type of tasks for supporting every kind of disaster (Figure 16). These are

- Planning and Analysis
- Data Management
- Field Operations, and
- Situational Awareness



FIGURE 17 – CORE CAPABILITIES OF GIS IN DISASTER MANAGEMENT

Planning and Analysis

GIS is the most complete information system for analyzing, modeling, and displaying community vulnerability. When hazard locations can be viewed along with critical infrastructure, critical values at highest risk become apparent. Models can be processed to determine potential impacts and appropriate mitigation requirements. When events occur, response preparedness is more comprehensive. The basic foundation of developing an emergency management program is the analysis of risks and hazards to determine values at risk and operations necessary to reduce exposure, respond effectively, and recover quickly.

Data Management

To achieve comprehensive preparedness, a great deal of information must be gathered and maintained in advance of an event. Accurate cataloging of GIS data and services, combined with your organization's existing investments, gives you an edge for turning raw data into useful information.

Field Operations

Getting accurate information from field operations back to the command center can be a difficult challenge. Field crews can easily capture data and have it sent back for incorporation in the common operating picture. Commanders get a more accurate and dynamic understanding of conditions on the ground. New data can be sent to field teams so they have the best information possible for staying safe and protecting lives.

Situational Awareness

Situational awareness is the corner stone of emergency and disaster management. As an emergency unfolds, it is paramount to an effective response to understand the current

circumstances and to monitor events as they dynamically unfold over time. You need to know what's happening and where, and you have to be able to see it in real time. GIS aids in quickly establishing full situational awareness by linking people, processes, and information together using geography. It provides the map interface into getting a handle on an emergency and nimbly adjusting to change.

Leveraging GIS Locally

There are many success stories of utilizing the capabilities of GIS in disaster worldwide but we will focus on its successes locally at the Office of Disaster Preparedness and Management (ODPM) and the Tobago Emergency Management Agency (TEMA).

ODPM

The Office of Disaster Preparedness and Management was established by Cabinet in January 2005. ODPM is responsible for leading the National effort in protecting public health and safety; restoring essential government services; and providing emergency relief to those affected severely by hazards and it the coordinating entity which leads Trinidad and Tobago's efforts in preparing for, responding to, and recovering from disasters.

Consequently, the ODPM is committed to formulating an all-hazard approach to emergency/risk management. This all-hazard approach encompasses a comprehensive framework that includes mitigation, preparedness, response and recovery and is reflected in the ODPM's vision and mission

TEMA

The National Emergency Management Agency (Tobago) was established in accordance with The Tobago House of Assembly Executive Council Minute No. 64 of March 09, 1998. After careful consideration, the Executive Council of the Tobago House of Assembly, by Executive Council Minute No. 722 of October 2008 decided on a change of name which would more accurately define the jurisdiction of the agency. That new name is Tobago Emergency Management Agency (TEMA).

TEMA, therefore co-ordinates a network of agencies and individuals within the island of Tobago, to direct their efforts to the maximum preservation of life and the protection of property in times of disaster.

The Core Areas of Work Where GIS is applied at these agencies

Core Area	Activities
Preparedness and Mitigation	Hazard, Vulnerability, Risk, Susceptibility mapping and modelling, Evacuation and egress mapping, public awareness and education, data collection for decision support, Early Warning systems, Critical facilities mapping
Response	Providing Situational awareness and COP in emergency, Incident mapping, asset management, location based services
Relief and Recovery	Damage Assessments

At TEMA, these tools are used

- ESRI ArcGIS 9.3.1 software (Desktop)
- WebEOC
- DNR Garmin
- Map Source
- Interactive GIS – Google Earth
- Mobile Tools
- Garmin GPS (GPSmap 76CSx and Oregon 550)
- Blackberry and Androis Phones (GPS enabled)
- iPads
- Presicion Point and MNAV systems

What is done with data collected and products

- Data collection – Incident and Hazard
- Data Sharing with other agencies – Division of Health and Social Services, Division of Settlements and Labour, Division of Infrastructure and Public Utilities, WASA etc
- Mapping
- Hazard, Vulnerability and Risk mapping
- Incident and hotspot mapping
- Socio-economic and demographic mapping
- Emergency Resources mapping
- Critical Facilities mapping
- Evacuation mapping

- Vehicle Tracking and monitoring

At ODPM, these tools are used

- ESRI ArcGIS 9.3.1 software (Desktop, Server)
- Interactive GIS – Google Earth, ArcExplorer Desktop/ Online application /ODPM GIS Web Interface
- Mobile Tools
- Garmin GPS (GPSmap 76CSx)
- Blackberry (GPS)
- i-Pad applications
- MNAV systems

ODPM's data and products

- Data collection – Hazard data
- Data Sharing with other agencies – WRA (flood data) , MoT (landslide data)
- Mapping
- Hazard, Vulnerability and Risk mapping
- Incident and hotspot mapping
- Loss and Damage Assessment
- Socio-economic and demographic mapping
- Emergency Resources mapping
- Critical Facilities mapping
- Evacuation and Egress mapping

GIS Analysis

- Landslide and Flood susceptibility models
- Landslide and Flood risk models
- Routing (MNAV system, exploring development of a routable roads network dataset)

CHAPTER 6

GIS in the Workplace

RRMC GIS Operations

Mayaro Rio Claro Regional Cooperation

It is easier for most small organizations to integrate GIS into their workflow. Smaller organizations tend to have a more intimate personnel structure which helps to support changes in the organization. The decision to start using GIS may be one the organization decided together and in cases like these people are much more willing to learn and adapt to the necessary changes. Information and ideas are worked and reworked much faster and it is much easier to appreciate the individual view of personnel in the organization.

Initially the data that is used would mainly come from your own organization. Data collecting in the past now needs to be formatted, where possible, for use in the GIS.

At the end of this chapter

- you should have thought of the way forward for your regional cooperation
- its goals and
- how GIS can be integrated

GIS Integration

Your Workflow – field officers now have to carry and use a GPS receiver, your present database will change to accommodate spatial information or you now have a database.

Your Outputs – Your ways of interacting with public may change, the way you offer information may change.

Your financial allocations – you may decide to cut less critical budget lines to fund a GIS.

Your functionality and efficiency – a well designed GIS will help improve the way you store, use, capture geographic information.

Why start a GIS?

- Improvement in data management
- Improved data organization for decision making
- Better data analysis – both graphical and tabular
- No need for multiple databases
- Simplification in update process
- Business advantage

When should I start?

Now!!!

This is the way the world is moving. This is how geographic information is being stored, shared and analyzed. Until you start a GIS, you're missing out on that.

Costs

The size of project is directly related to the magnitude of costs. Small organizations will have relatively small costs. Cost at start up, however, is always the most expensive.

Requirements

- Personal Training
- Funding
- Technical Support

These requirements are true for any organization but it is especially true if you are a small one. Through personnel training, staff can be motivated to actively be a part of shaping the GIS and can be persuaded to take on the additional roles and responsibilities that it would entail.

Whether it is from organization's funds or from outside sources, this is important. Start-up costs are always more expensive since you would need to buy equipment, software, and data, and in some cases pay for training. Data from an outside agency for your GIS would depend on what you expect to deliver.

Technical support is a constant fact of a GIS, whether for hardware servicing of GPS receivers, computers, printers, scanners or the software side – GIS applications, database management. Usually vendors of the particular item, be it hardware or software, would handle the technical support however technical support would be necessary for setting up of the GIS and database management as well. GIS analysts, specialists and technicians are the ones who can help guide you through the process of bringing together your needs with a tailored GIS that works for you.

To Start....

Goals

- What do you hope to achieve?
- How do you think GIS can help your organization?
- Develop a long term plan for integrating GIS into your organization

Planning: How to integrate

- Meet the organization's needs – integrate it into your workflows
- Employees need to have say in how the system is managed – it needs to be accessible to them. This is practical since ideally they would be using it.
- Show how GIS can benefit everyone in the workplace – more flexible, some tasks are now simpler
- Train and educate staff

Needs Assessment

- What type of database is needed?
- Type of data for decision making?
- Types of maps?
- How can the GIS enhance your goals?
- How does GIS play into your outputs and by extension enhance that?
- What type of analysis would you need to focus on?

Remember, any GIS needs these 5 critical components: Hardware, Software, People, Data, Policy and Procedure

Hardware and Software: the computing power behind the GIS. Together analysis, storage and display are processed with these. It is therefore necessary to:

1. Use software that has all the tools needed to achieve your organizations' or project's goals. Free applications don't always have what you would need. Evaluate each potential GIS application considering:
 - a) Does it do what I need
 - b) The long term (remember integrating GIS is a long term process)
2. Get hardware that is capable of handling the GIS processing needed. GIS applications typically require substantial memory, storage and graphical resources.

Data: One of the more important components as well as the most expensive. If possible set up a data sharing policy with other organizations. This helps to reduce long term cost and data duplication. The most common source of attribute data is your own. Keep updating your data; it is much more valuable current.

People: GIS is an interdisciplinary field. For it to run successfully, it requires a combination of skills not just from a GIS technician or officer but also the technical knowledge and experience of the organization.

Policy and Procedure: Develop a policy for creating, saving, storing information. Have a backup system in place. Set up procedures for field work and how that data is processed. Know what you want from your database and make it work for you.

Also, you should keep in mind that quality of your GIS analysis will be affected by:

- The type of data you have
- The amount of data you have available to you
- Your level of training

Constraints

Your GIS constraints can be the cost of hardware and software and even the cost of data, but this shouldn't deter your usage but determine your way forward.

Go through **Appendices 1 – 4**, observe the changes highlighted, which should allow GIS to be incorporated effectively into your corporation

With all the key points addressed over the course of this manual, GIS has to now be incorporated into this unit. These points can be checked by the MRCRC staff from start to finish in your day to day workflow when GIS data is being collected.

- ✓ Incident is reported and a team is required to do an assessment
- ✓ Have your Waypoint form and/or Survey form with Waypoint and Coordinate spaces included in the field survey forms ready to go
- ✓ GPS units checked and ready for use
- ✓ When in the field, ensure proper satellite reception to mark data onto GPS
- ✓ Immediately record coordinate and waypoint data on forms when collected
- ✓ If GPS is not used, use Google Earth/ Arc Explorer (Chapter 7) to find location, mark and record coordinates on form and don't forget to SAVE the waypoints
- ✓ Ensure that there is a standard for all the waypoints / icons used. E.g. All landslides are represented with the same icon, all floods have the same icon and likewise all similar icons e.g. schools, shelters, early warning points etc.
- ✓ Create / Update forms excel worksheet to include coordinate information
- ✓ Forms created in Microsoft Excel can be saved in GIS format (.csv) and uploaded into the GIS mapping software for visualization (Appendix 6)
- ✓ Maps can then be created for your specific purposes by taking screen shots and using the template (Figure 18)
- ✓ Ensure the basics of map making are adhered to at all times

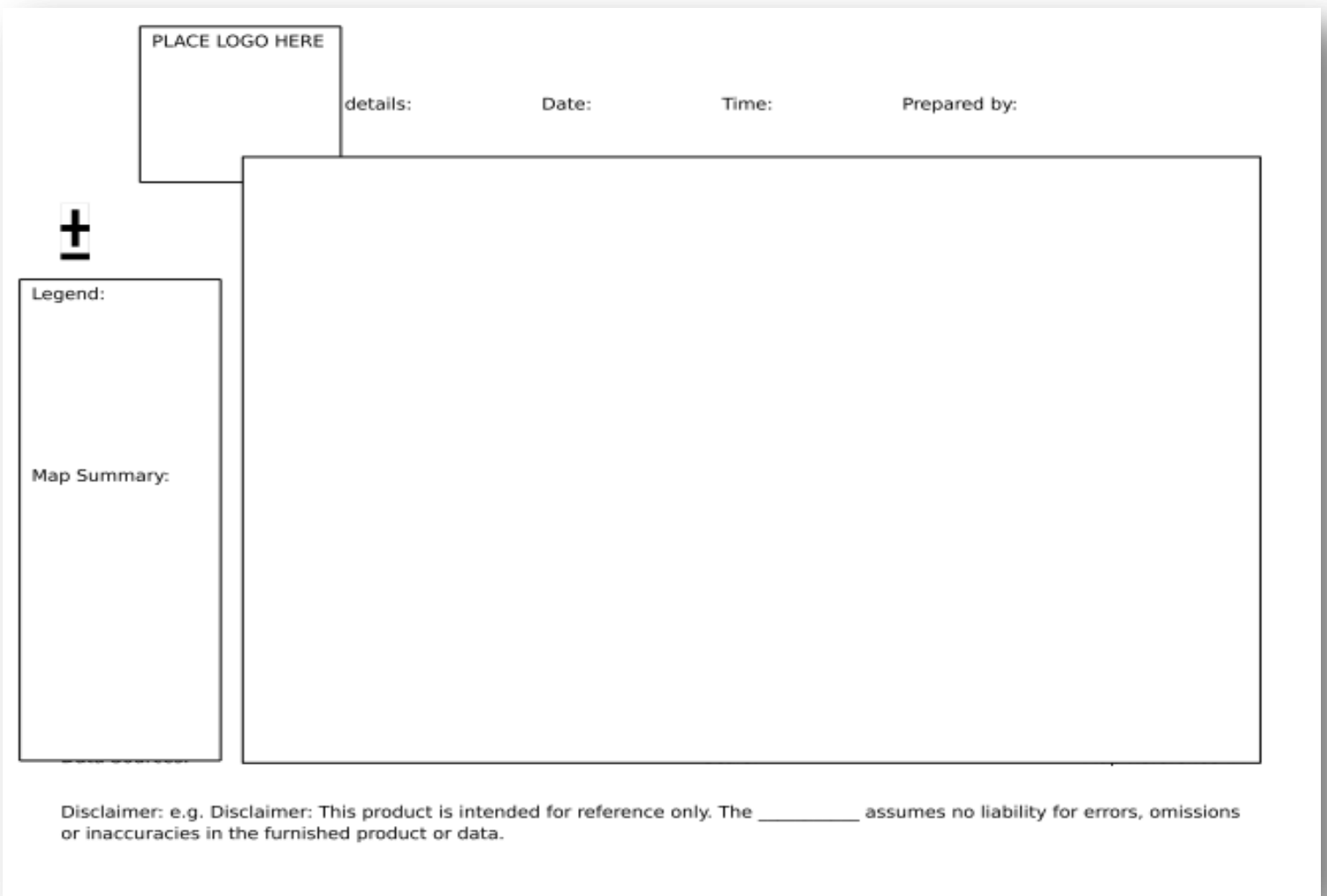


FIGURE 18 – BASIC MAP LAYOUT

CHAPTER 7

GIS Tutorials

In this chapter, the focus will be on the use and applications of two free open source software applications; **Google Earth and ArcGIS Explorer Online**; and getting the hands on in their use. This component is entirely practical.

Go to **Appendices 5, 6 and 7** for user instructions for both applications.

CHAPTER 8

Scenarios

This Chapter is to observe GIS at work and how well participants understand the use of GIS and their individual functions within the RRMC in GIS Operations and the MRCRC.

Participants are to organize themselves in groups and do the following scenarios

- **Scenarios 1 - Fallen Tree**

At 9:45am on Friday 20th Sep 2013 Mr. Seals called the (DMU) MRCRC to notify them that a tree had fallen and blocked a major road. We need a team (to visit the site to conduct an assessment and record and report the coordinates for later reference.

Persons will go out site for the clue (Tree at site). Take the coordinates; fill out their incident report form; tag the event on a software aka Google Earth and verbally report to us.

- **Scenarios 2 – Tsunami Threat**

The Trinidad and Tobago MET Office has reported a possible Tsunami Threat off the peninsula Point Radix, Mayaro. We need a team to identify the Early Warning Points in close proximity to the threat location and inform us on which communities are at high risk of serious impact so we can inform them of the impending threat.

This involves using Google Earth and Participants will identify communities and do follow up reports to the correct authorities.

- **Scenarios 3 – Strong Winds**

We just got a report that Several Areas are experiencing Extreme HIGH Winds description of situation “**Mini -Tornado in Trinidad**”. Currently we have roofs of 3 Homes being blown off on Tyndale Street , no injuries reported. However on Alexis Street Mrs. Mable a special needs 69 year old female is trapped in Redman’s Corner Shop and needs to be Evacuated to the nearest Hospital or Shelter.

Groups will then report individually on their scenarios. The lead person of the group will

1. Identify the Scenario
2. Discuss the plan and approach taken
3. Say what problems were encountered, and
4. What were the results and recommendations

Cool Question....

The facilitator is at the EOC, and you are at the location of an incident in a CERT or TEMA Van, Your GPS Device has no battery Power and you are unable to buy a replacement. The facilitator needs the coordinates of the location to report to add to the WebEOC Incident Report and the First Responders to give assistance.... What advice can you give her?

The Vans have GPS’ let’s see who can remember that! 😊

CHAPTER 9

Glossary

ArcGIS: Computer software for implementing a geographic information system (GIS)

ArcView: Desktop GIS software that includes ArcMap for displaying and interacting with maps and layouts, and Arc Catalogue for previewing data and metadata

Attribute: A piece of information that describes a geographic feature on a GIS map. The attributes of an earthquake might include the date it occurred, its latitude and longitude, depth and magnitude.

Attribute table: A table that contains all of the attributes for like features on a GIS map, arranged so that each row represents one feature attribute. In a GIS, attribute values in an attribute table can be used to find, query and symbolise features. The attribute table for the Top 10 cities, 1950 layer includes attributes for each of the ten cities listed.

Axis: The vertical (y-axis) for horizontal (x-axis) lines in a graph on which measurements can be illustrated and coordinated with each other. Each axis in a GIS graph can be made visible or invisible and labelled.

Bookmark: In ArcMap, a shortcut you can create to save a particular geographic extent on a map so you can return to it later. Also known as a spatial bookmark.

Colour selector: The Window that allows you to change the colour of geographic features and text on your GIS map.

Data: Any collection of related facts, from raw numbers and measurements to analysed and organised sets of information.

Data folder: A folder on the hard drive of your computer or your network's computer that is available for storage of GIS data and map documents that you create.

Data frame: A map element that defines a geographic extent, a page extent, a coordinate system, and other display properties for one or more layers in ArcMap. In data view, only one data frame is displayed at a time; in layout view, all a map's data frames are displayed at the same time. In the layout view, the active data frame has a dashed line around it to show it is the active one.

Data source: The data referenced by a layer or a layer file in ArcMap or ArcCatalog. Examples of data sources are a geodatabase feature class, a shapefile, and an image.

Data View: A view in ArcMap for exploring, displaying, and querying geographic data. This view hides all map elements, such as titles, north arrows, and scale bars. Compare layout view.

Datum: A standard position or level that measurements are taken from, in this case location.

Decimal degrees: Degrees of latitude and longitude expressed in decimals instead of in degrees, minutes and seconds. Decimal Degrees converts the degrees, minutes, and seconds into a decimal number using the mathematical formula below. In a GIS, decimal degrees is more efficient than degrees, minutes, and seconds because they make digital storage of coordinates easier and computations faster.

$$\text{Decimal degrees} = \text{degrees} + (\text{minutes} / 60) + (\text{seconds} / 3,600)$$

Feature: A geographic object on a map that represents a geographic object too narrow to show as a polygon at a particular scale. A line feature might represent a river on a world map or a street on a city map.

In ArcGIS, another type for a line feature is a polyline feature. A polygon feature is an area on a map that represents a geographic object too large to show as a point or a line. A polygon feature might represent a lake, or a city viewed from an airplane, or a whole continent viewed from a satellite.

Feature class: A collection of geographic features with the same geometry type (point, line, or polygon), the same attributes, and the same spatial reference (coordinate system and map projection).

Field: The column in a table that contains the values (information) for a single attribute of each geographic feature in a GIS layer.

Field name: The column heading in an attribute table. Because field names are often abbreviated, ArcGIS allows you to create an alternative name, alias that can be more descriptive.

Find button: An ArcMap button used for locating one or more map features that have a particular attribute value.

Folder connection: A shortcut that allows you to navigate to a folder without having to enter the entire path.

Geodatabase: A database used to organise and store geographic data in ArcGIS

Geographical Coordinate System: A geographical coordinate system is a system that uses latitude and longitude to describe points on the spherical surface of the globe.

Georeference: To assign coordinates from a reference system, such as latitude

Graduated colour map: A map that uses a range of colours to show a sequence of numeric values. For example, on a population density map the more people per square kilometre the darker the colour.

Graph: A graphic representation of tabular data.

Identify tool: An ArcMap tool used to display the attribute of features in the map.

Image: A graphic representation of data such as a photograph, scanned picture, or satellite photograph.

Join: An operation that appends the fields of one table to those of another through an attribute field common to both tables. A join is usually used to

attach more attributes to the attribute table of a map layer so that these attributes can be mapped. For example, you could join a country table with population data to a country attribute table.

Label: Text placed next to a geographic feature on a map to describe or identify it. Feature labels usually come from an attribute field in the attribute table.

Latitude: The angular distance north or south from the equator to a particular location. The equator has a latitude of zero degrees. The North Pole has a latitude of 90 degrees North; the South Pole has a latitude of 90 degrees South.

Layer: A layer is a set of geographic features of the same type along with its associated attribute table, or an image. Example layers are “Major cities”, “Countries”, “Satellite Image”. A layer references a specific data source such as geodatabase feature class or image. Layers have properties, such as layer name, symbology, and label placement. They can be stored in map documents (.mxd) or saved individually as a layer (.lyr). See also data source.

Layer, turn on: Turning on a layer allows the layer to display in the map. In ArcMap, a layer is turned on by placing a check mark in the box next to the layer name in the table of contents.

Layer file: In ArcGIS, a file with a .lyr extension that stores the path to a data source and other layer properties, including symbology.

Layout: In ArcMap, an on-screen presentation document that can include maps, graphs, tables, text, and images.

Layout view: A view in ArcMap in which geographic data and map elements, such as titles, legends, and scales bars are placed and arranged for printing.

Legend: A list of symbols on a map that contains a sample of each symbol as well as text that identifies what the symbol represents.

Line: See feature.

Longitude: The angular distance east or west from the north-south line that passes through Greenwich, England, to a particular location. Greenwich, England has a longitude of zero degrees. The farther east or west of Greenwich you are, the greater your longitude.

Magnifier window: A window in Arc Map data view that shows a zoomed-in view of a small area of the main map. Moving the magnifier window around does not change the extent of the map underneath.

Map document: In ArcMap, the file that contains one or more frames and the associated layers, tables, graphs, and reports. Map document files have an .mxd extension.

Map projection: A method by which the curved surfaces of the earth are portrayed on a flat map. Every map projection distorts distance, area, shape, direction, or some combination thereof. Map projections are made using complex mathematical formulas that are part of ArcGIS software's automatic functions.

Map Tip: In ArcMap, a pop-up label for a map feature that displays when the mouse is paused over that feature. The label comes from a field in the layer attribute table.

Measure tool: ArcMap tool used to measure distance on a map.

Metadata: Information about the content, quality, condition, and other characteristics of data. Metadata may include a brief description of the data and its purpose, the names of the authors or compilers of the data, the date it was collected or created, the meaning of attribute fields, its scale and its spatial reference (coordinate system and map projection).

Origin: A location in a coordinate system where eastings and northings are equal to zero.

Pan: To move your map up, down, or sideways without changing the viewing scale.

Point: See feature.

Polygon: See feature.

Polyline: See feature.

Projection: See map projection.

Record: A row in the attribute table that contains all of the attributes values for a single feature.

Relate: An operation that establishes a temporary connection between records in two tables using a field common to both. Unlike a join operation, a relate does not append the fields of one table to the other. A relate is usually used to associate more records and their attributes to the attribute table of a map layer. For example, you can join a world cities table to a country layer attribute table.

Scale: The relationship between a distance or area on a map and the corresponding distance or area on the ground, commonly expressed as a fraction or ratio. A mapscale of 1/100,000 or 1:100,000 mean that the unit of measure (e.g., one inch) equals 100,000 of the same unit on the earth.

Selected feature: A geographic feature that is chosen and put into a subset so that various functions can be performed on the feature. In ArcMap, a feature can be selected in a number of ways, such as by clicking it on the map with the select features tool or based on one or more of its attributes. When a geographic feature is selected it is outlined in blue on the map. Its corresponding record in the attribute table is highlighted in blue.

Shapefile (.shp): A data storage format for storing the location, shape and attribute information of geographic features. A shapefile is stored in a set of related files and contains one feature class.

Source data: See data source.

Sort ascending: To arrange an attribute table's rows in order from the lowest values to the highest values in the field. For example, number values should be ordered from 1 to 100, and alphabetical values would be ordered from A to Z.

Sort descending: To arrange an attribute table's rows in order from the highest to the lowest values in the field. For example, number values would be ordered from 100 to 1, and alphabetical values would be ordered from Z to A.

Spatial: relating to space.

Symbol selector: The dialog in ArcMap for selecting symbols and changing their colour, size, outline, or other properties.

Table of Contents (TOC): A list of data frames and layers on a map that may also show how the data is symbolised.

Toolbar: A set of commands that allow you to carry out related tasks. The Main Menu toolbar in Arc Map has a set of menu commands; other toolbars typically have buttons. Toolbars can float on the desktop in their own window or may be docked at the top, bottom, or sides of the main window.

Vertex: One of the points that define a line or polygon feature.

Zoom: To display a larger or smaller extent of a GIS map or image.

CHAPTER 10

Appendix

1. MRC Hazards
2. RRMCC Organizational Chart
3. Ashok Roof Event Form
4. MRCRC All Events Database
5. Google Earth User Guide
6. Sharing and Saving Places data
7. Importing CSV data
8. ArcExplorer Online Quick Guide