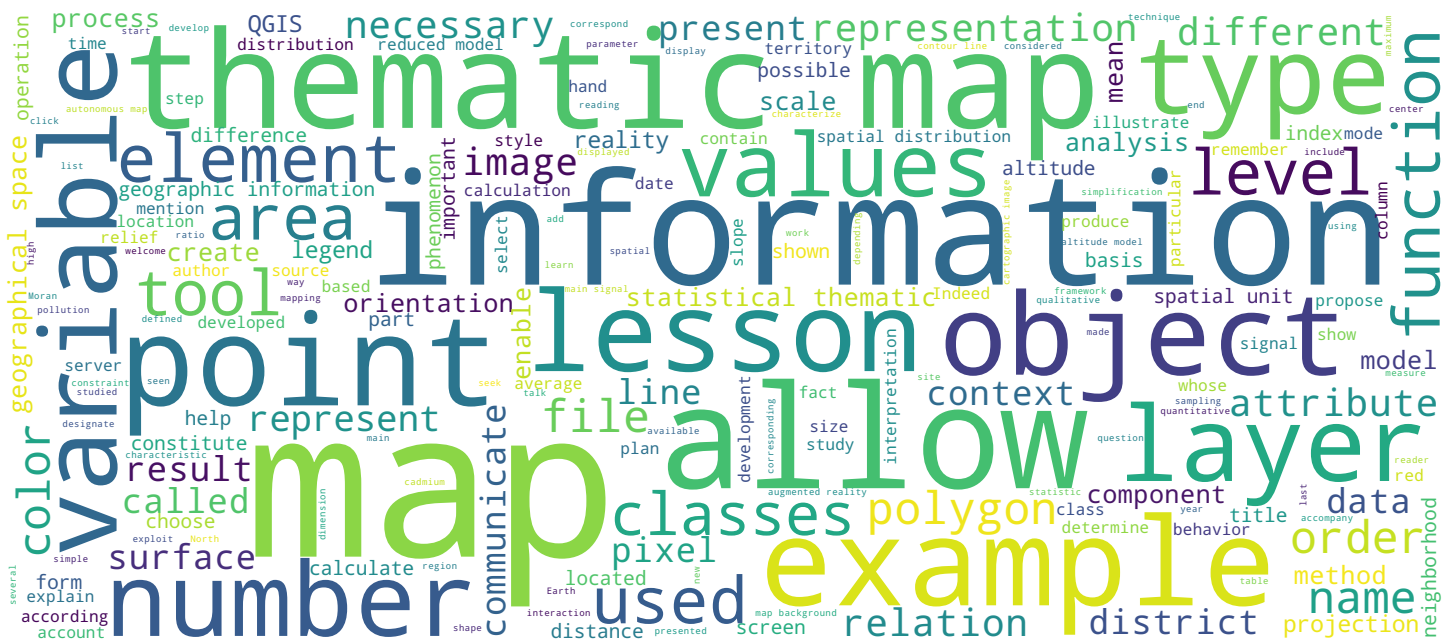


Thematic Maps and the Semiology of Graphics

Map Components and Functions

Stéphane Joost, Marc Soutter, Fernand Kouamé, Amadou Sall



Search MOOC



Video



Representing Geographic Information



Lesson objectives

- Introduce the different types of thematic maps
- Explain the functions and components of a map
- Outline the steps to create a map

After this lesson you should be able to

- Name the different components and functions of a map
- List the steps to create a map

Geographic Information Systems

Hello and welcome to the last module of this introduction MOOC on geographic information systems. You will learn how to represent geographic information, particularly by applying the rules established in thematic mapping. On this basis, you will learn how to process the quantitative or qualitative information that you want to communicate and we will show you how to produce thematic maps in QGIS with the help of the printing dialer. The last three lessons will be devoted to particular cases, so to dynamic and interactive mapping on the Internet, the three-dimensional representation and finally the augmented reality. But first, in this first lesson, we will talk about mapping, components and functions of the geographic map. The goals of this lesson are firstly, in general, to recall briefly what the cartography is, what maps are and what they are used for, then, we will explain the differences between the main types of thematic maps before presenting the functions and the components of the map, we will then mention the various steps of manufacturing of a map and at the end of the lesson, you will be able to name all the components and all the functions of a map and also to establish the list of steps of the manufacturing of a thematic map.

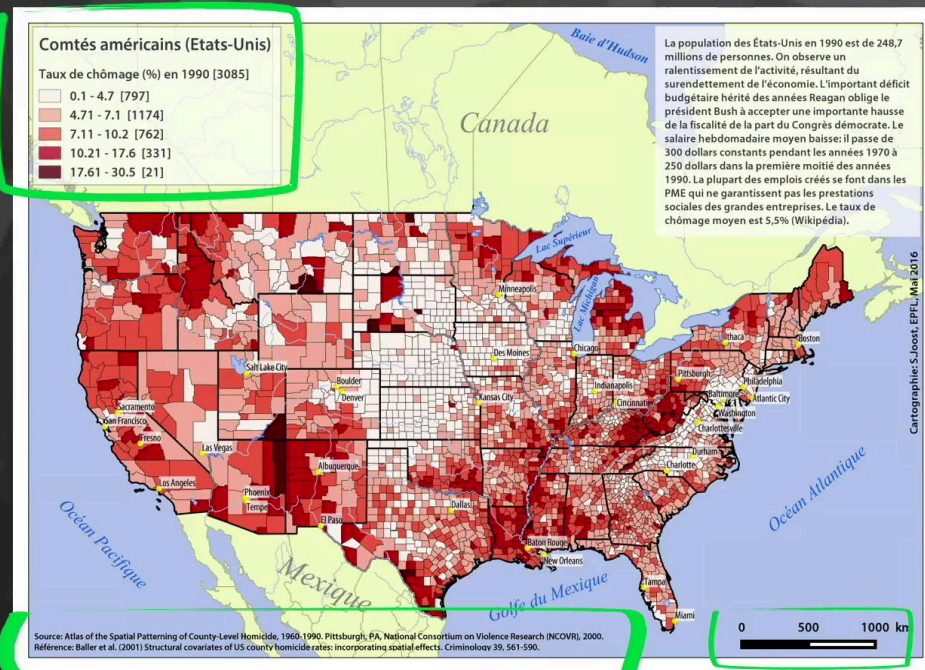
Notes

Summary



0m 31s

Thematic Mapping and the Semiology of Graphics



Constraints / rules

- Colours
- Components
- Legend
- Scale
- Data sources

Geographic Information Systems

The main object of the first 4 lessons devoted to the representation of geographic information is to teach you how to design statistical thematic maps as shown here on the screen. This is the type of map that is most often used to represent and communicate the collected or processed information in the context of research activities or land management. The development of this type of tool must be carried out while respecting a certain number of constraints which respect will favor the efficiency of the transmission of the information. For example, it is necessary to use the colors following the rules of the graphic semiology or to include all the useful components such as a legend, a scale, the sources or a comment, in order to allow an optimal reading.

Notes

Summary



1m 57s

Sources



- J. Bertin, La graphique et le traitement graphique de l'information, Flammarion, Paris, 1977, 250 p.
- R. Brunet, La carte mode d'emploi, Ed. Fayard Reclus, Paris 1990, 270 p.
- M. Cosinschi, Cartographie, Institut de géographie de l'Université de Lausanne, 2008, Lausanne, 178 p.

Geographic Information Systems

The subject taught in these 4 lessons dedicated to thematic mapping is drawn from three main sources or influences. It is Jacques Bertin's graphic, Roger Brunet's contributions and the Reclus public interest group in Montpellier as well as works by Micheline Cosinschi at the University of Lausanne. The theoretical bases proposed by these scientists, accompanied by a few years of practice have allowed to develop the content that we propose here. We will first review some basic notions in general cartography, locate statistical thematic maps in relation to other types of thematic maps, before addressing the components and functions of the map and finally the manufacturing process.

Notes

Summary



2m 48s

Cartography



- HyperGeo, <http://www.hypergeo.eu/>
- A science
- An art
- A technique
- Representation of the Earth

Geographic Information Systems

The online electronic encyclopedia with free access Hypergeo rightly presents the mapping as a science, an art and a technique. A science because its bases are mathematical with regard to the determination of the shape and the dimensions of the Earth or the transfer of the curved surface of the planet on a plan thanks to the projection system. An art because the cartography is a mode of graphic expression and it must present aesthetic and didactic qualities in order to exploit at best the visual capacities of the readers. A technique because the realization of maps requires the mobilization of tools and technologies whose progress has regularly changed and improved the cartographic production process. We can think of aerial photos, satellite images, computing contributions, and so on. The Astronomy, the geodesy, the topography and the photogrammetry, the topometry, the remote sensing, and the satellite imagery are all disciplines which contribute to the improvement of the available map backgrounds. That said, The purpose of mapping is the representation of the Earth or possibly another celestial body in a geometric and graphical form through the design and realization of maps.

Notes

Summary



3m 37s

Cartography



- HyperGeo, <http://www.hypergeo.eu/>
- A science
- An art
- A technique
- Representation of the Earth
- Geo-Graphy
- 2-dimensional combinations of:
 - Shapes, positions
 - Sizes, orientations

Geographic Information Systems

To represent geographically the objects that constitute the world and to express the complexity of their relations, mapping is a bidimensional combination of shapes, positions, sizes and orientations in simultaneity.

Notes

Summary



4m 51s

Cartography



- Khartès, mappa
- From 3D to 2D
- Representation
 - Mental image (mapping)
 - Process of creation (map-making)
- A tool for:
 - Understanding
 - Observation and visualization
 - Analyzing spatial phenomena
 - Sharing knowledge and know-how

Geographic Information Systems

Mapping is therefore a system of synoptic signs which allows to communicate like the language. Originally, the word map comes from the designation of its support in ancient Greek, khartès, the parchment, and mappa, the piece of cloth. The constituent element of the map is the operation of projection of the geographical space on a plan, so the constraint of the passage from three to two dimensions. Consequently, a frequent definition of the map is that it is a representation of all or part of the surface of the Earth on a plan. This representation designates both the mental image that relates to an object or a georeferenced phenomenon and the process by which a map is created. The map is therefore both an image category and the product of a representation. The map is above all a tool which allows to apprehend specific arrangements of objects in the geographical space that we seek to understand or interpret. It is then an instrument capable of feeding the scientific knowledge and allowing to observe, discover or decode the relations between natural and socio-economic phenomena on the territory. The map also allows to capitalize or store knowledge and thus to transmit knowledge.

Notes

Summary



5m 05s

Thematic Maps

- Graphical representation of a georeferenced phenomenon
- At minimum one theme
- Simplification of reality (see module 1)
- XY = secondary aspect
- A topographic map is a thematic map
- Topographic map \neq thematic map

Les Mamelles, Dakar, Opentopomap.org



Geographic Information Systems

A thematic map is a graphical representation of the spatial distribution of one or more attributes of a phenomenon, whether it is quantitative or qualitative. A thematic map deals with at least one theme. It proposes a simplification of the reality by means of the representation of identifiable and significant elements. The localisation only constitutes a secondary dimension of the thematic map since its main role is to represent the selected theme. On this point, it is opposite to the topographic map which is a special thematic map and whose represented theme is that of the type of land use but whose primary function is indeed that of the location on the territory. We will admit that the primary purpose of a thematic map is the description of the geographical distribution of a phenomenon and its spatial variability without the precise location of the objects being necessary. Even if the thematic maps can include names of localities or elements of the landscape like a hydrographic network, topographic maps will not be included as thematic maps in the rest of this module.

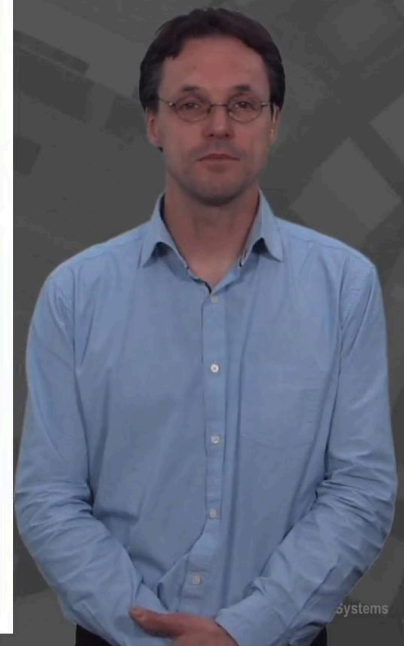
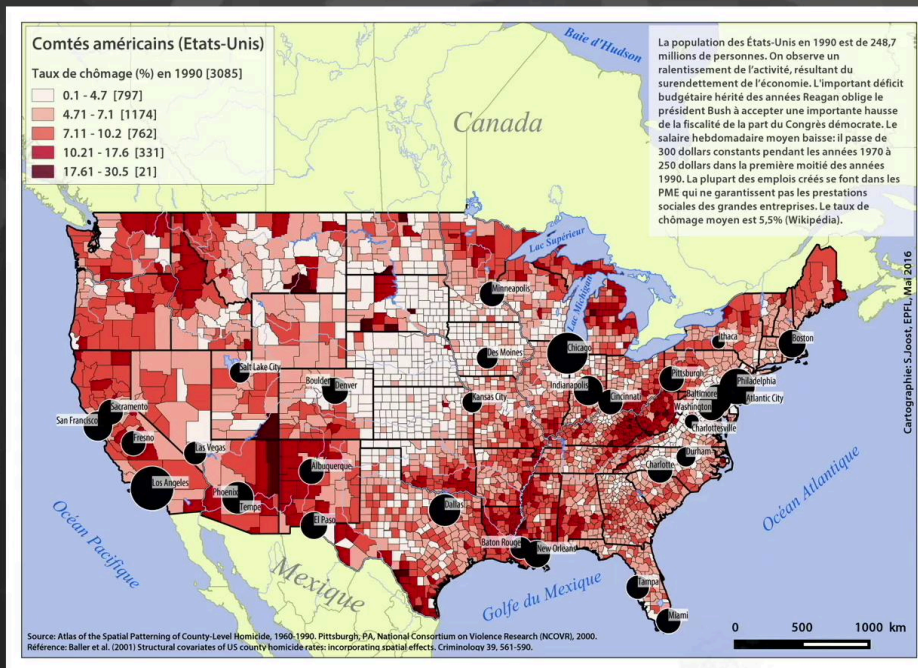
Notes

Summary



6m 25s

Types of Thematic Maps – Statistical Maps



Let's now mention three important types of thematic maps: the inventory map is a descriptive thematic map. It constitutes a first level of the representation of information. This type of map can be delicate to realize as it is a collection which has to allow to precisely locate an information that is often abundant whilst ensuring the best possible readability, the statistical thematic map uses simultaneously administrative spatial units such as the counties and states of the USA on this map and qualitative or quantitative data produced by the administration, such as the information on the unemployment rate in 1990, shown on the screen. This type of mapping requires a processing of the information, here a class setting or discretization of statistical data and implies an interpretative reading. The information processing requires precise methodological knowledge in statistics and specific modes of representation. The statistical map is a convenient means used to visualize large-scale or complex phenomena, in all cases very difficult to apprehend via tables of figures. In general, thematic statistical maps show colored surfaces or polygons and are called choropleth maps, or, the punctual geographic information is exploited in the form of circles or other proportional symbols.

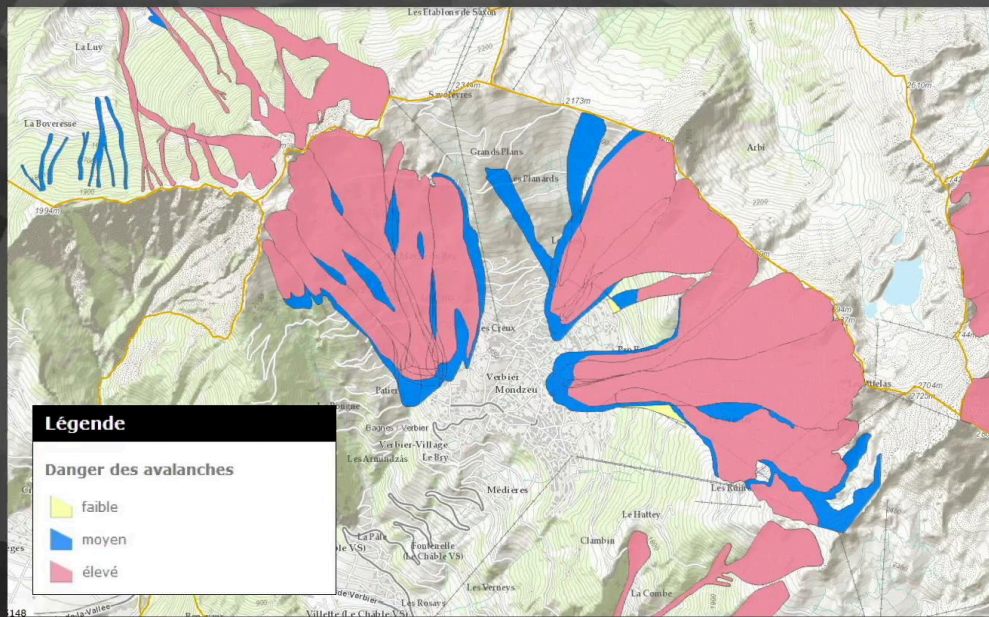
Notes

Summary



7m 33s

Types of Thematic Maps – Land-use Maps



Canton du Valais, <https://www.vs.ch/web/sfp/cartes-de-danger-avalanches>

Geographic Information Systems

The thematic planning map is often produced in the context of impact studies or territorial planning. It combines urban infrastructure informations, natural environments and socio-economic information. It is a category of maps which can be used by specialists first, then as a communication support for the general public after adaptation. We will also talk about a development plan in its political dimension. Risk or danger maps can be considered as thematic maps of development.

Notes

Summary



9m 03s

Role of Maps



- Represent, communicate
- Summarize large complex datasets
- Differentiate between information in geographic space
- Explore geodata
- Transmit information
- Integrated method
 - To inform, to research
 - To reflect, to teach, to support decision-making

Geographic Information Systems

Before reviewing the various components of the map, we propose you to stop for a moment on the role of this map. Beyond the considerations related to its design and functioning mentioned a moment ago, the maps fulfill several practical functions. First, they are useful to represent and communicate a georeferenced and therefore spatially distributed information. Then the maps are able to represent large volumes of complex data in a clear and synthetic way by structuring the information in order to be able to highlight differences in geographical space. They are also useful to explore geographic data and seek to highlight particular spatial distributions of the behavior of these data. And finally the maps are able to transmit the information in an accessible way because their aesthetics can please and attract attention. To conclude, a map is an integrated means which allows to inform, to seek, to think, to teach and to make decisions.

Notes

Summary



9m 37s

Advantages of Maps



- Synoptic expression
- Highlights important spatial properties
- Relative localisation
- Spatial structure

Geographic Information Systems

The evoked roles clearly reveal remarkable qualities but also faults. On the advantage side, we will mention the synoptic or simultaneous expression of the information which allows to highlight spatial properties imperceptible by other means.

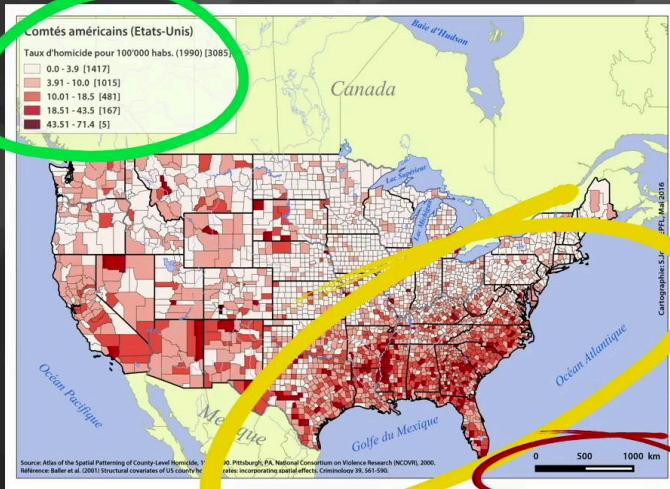
Notes

Summary



10m 42s

Advantages of Maps



- Synoptic expression
- Highlights important spatial properties
- Relative localisation
- Spatial structure
- Graphical conventions
 - Projection, scale
 - Legend
- Simplified model of reality
- Effective communication...
- ... if the map is good !

Geographic Information Systems

The relative location of objects in relation to each other in particular often reveals a spatial structure, such as here, the concentration of the homicide rate in the southern counties of the United States in 1990. Then, the graphic conventions available allow on one hand to reduce the geographical space thanks to the projection of the geoid on a plan and thanks to the scale. These conventions also allow to reduce the information to be processed thanks to the legend. We thus reach a reduced model of the reality that is very convenient to manipulate. Let's mention another key asset of the map which is the one that enables an effective communication. However, a bad map will not allow to transmit the information clearly.

Notes

Summary

11m 06s



Flaws of Maps



- Systematic generalizations and simplifications
- Appearance > information
- Interpretation
- Statistics without dynamicity of time
- Subjectivity of cartographic representation

Geographic Information Systems

On the fault side, it is certain that the maps cannot express everything, and as a simplification of reality, they show limits. To start with, the map always generalizes and simplifies the information. Then, the appearance of a map and its aesthetics can dominate the conveyed information. The reader's attention can be diverted by too sharp colors for example or a bad representation will give the impression that the information contained is of the same quality whereas this is not necessarily the case. The information from a map is always interpreted, even if a good comment accompanies it, and an interpretation can be wrong. The maps are mostly static, which excludes the temporal dynamics. Solutions exist, as in the case of the GeoDa software that you already know, or in the context of the implementation of the dynamic and interactive mapping on the Internet, which we will present to you during the last week. Another fault of the map comes from the subjectivity of the cartographic representation implemented by non-neutral and influential human beings. This subjectivity can be reflected at the level of the colors, a number of classes, a threshold between classes, the formulation of a title etc.

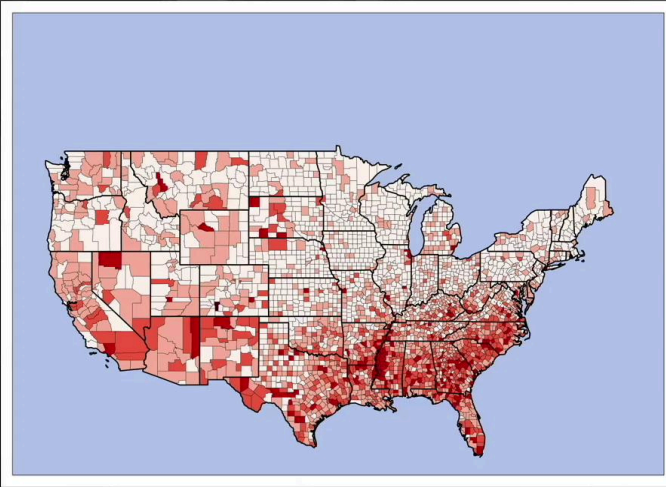
Notes

Summary



11m 45s

Map Components



- Model or image of reality
- System of signs established by the semiology of graphics
- Deformed, planar image
- Reduced image
- Simplified image

Geographic Information Systems

A map is made up of a number of elements. There is the reduced model of the proposed reality, so the main signal or the displayed image, but also a series of tools which enable to read the signal, which allow to optimize the transmission of information and to facilitate the interpretation. We will first look at the main signal and its characteristics before reviewing the other components of the map. Like an image, the map is a system of signs which belongs to the elementary sign system that man has developed to memorize, to communicate and to understand the observations related to the world around him. The image formed by the map is the equivalent of a language intended for our cognitive functions, able to exploit the sense of sight and obeying rules defined in graphical semiology. This image is a plane image, resulting from the projection of the geoid on a two-dimensional plan as you studied in lesson 2 of the first module of this MOOC. Because of this projection, the map is also always a distorted picture. The map is also an image reduced by the scale of representation applied, it is a simplified image since it constitutes, as we have seen, a reduced model of reality and this simplification is mainly the result of generalization processes and sometimes of schematization.

Notes

Summary



13m 09s

Map Components

Systematic

Legend

Scale

Orientation

Data source

Date of data collection

Context-dependent

Title

Author

Date of creation

Information on the spatial units
(e.g. date of state division)

Explanation

Frame

Coordinate System

Projection

Labels

Inset maps

Grid

Nomenclature

Index

Geographic Information Systems

Our cartographic image is also a collection of conventional signs or symbols used to represent elements of the geographical space. According to De Saussure's work in semiology, a sign is composed of a signified which designates the mental representation of the associated concept, and a signifier, which designates the acoustic image of a word, the whole forming a seme or a meaning unit. This leaves room for various interpretations and to avoid possible confusions we use conventions such as the fact that the North is located at the top of the map or those that are controlled by the graphical semiology rules promulgated by Jacques Bertin in 1967. The list of signs used is given in the legend. It enables to justify or explain any deviation from the conventions. The legend is a key element of the map which presents the directory of signs used to compose the image. The image produced is ultimately an interpretation, so the subjective production of a cartographer who made his own choices to elaborate his signal. Regarding the other components which accompany the main signal and facilitate its reading, they are listed in the table on the screen. The first column contains the elements which must accompany the image of the map.

Notes

Summary



14m 36s

Map Components

Systematic	Context-dependent	
→ Legend	→ Title	Projection
→ Scale	→ Author	Labels
→ Orientation	→ Date of creation	Inset maps
→ Data source	→ Information on the spatial units (e.g. date of state division)	Grid
→ Date of data collection	Explanation	Nomenclature
	Frame	Index
	Coordinate System	

Geographic Information Systems

In the other two columns, we can see the elements that may or may not appear depending on the context. Indeed, it can be an autonomous map, a map that accompanies a newspaper article, which illustrates a book chapter, or a map in an atlas. In short, as many contexts which make a title, the name of an author, the date of creation or a comment not necessarily accompany a map directly. The importance of the legend and scale have already been mentioned, the orientation and convention related to the indication of the North as well. It is then essential to include the source of the attribute data used which are at the heart of the signal represented. The reader should also be informed of the date to which the data correspond, and the presence of all other elements will depend on the context. On autonomous maps, the title is obligatory, as well as the names of the authors. The date of creation provides useful information on the historical context in which a map has been developed. It is also important to provide information on the geographical data that have been used, in particular the year during which the cutting used was in force.

Notes

Summary



15m 57s

Map Components

Systematic	Context-dependent	
→ Legend	→ Title	→ Projection
→ Scale	→ Author	→ Labels
→ Orientation	→ Date of creation	→ Inset maps
→ Data source	→ Information on the spatial units (e.g. date of state division)	→ Grid
→ Date of data collection	→ Explanation	→ Nomenclature
	→ Frame	→ Index
	→ Coordinate System	

Geographic Information Systems

A comment must accompany an autonomous map, for which no context can come to the help of the reader who can misunderstand the signal. The framework is often used, its role being to clearly show the limits within which it is necessary to consider the components useful to the reading of the cartographic image. Coordinate and projection systems are not indispensable and their absence rarely compromises the comprehension of a map. Labels, zooms, display of the graticule, nomenclature or index are rarely useful but could be necessary in the case of inventory thematic maps, for example.

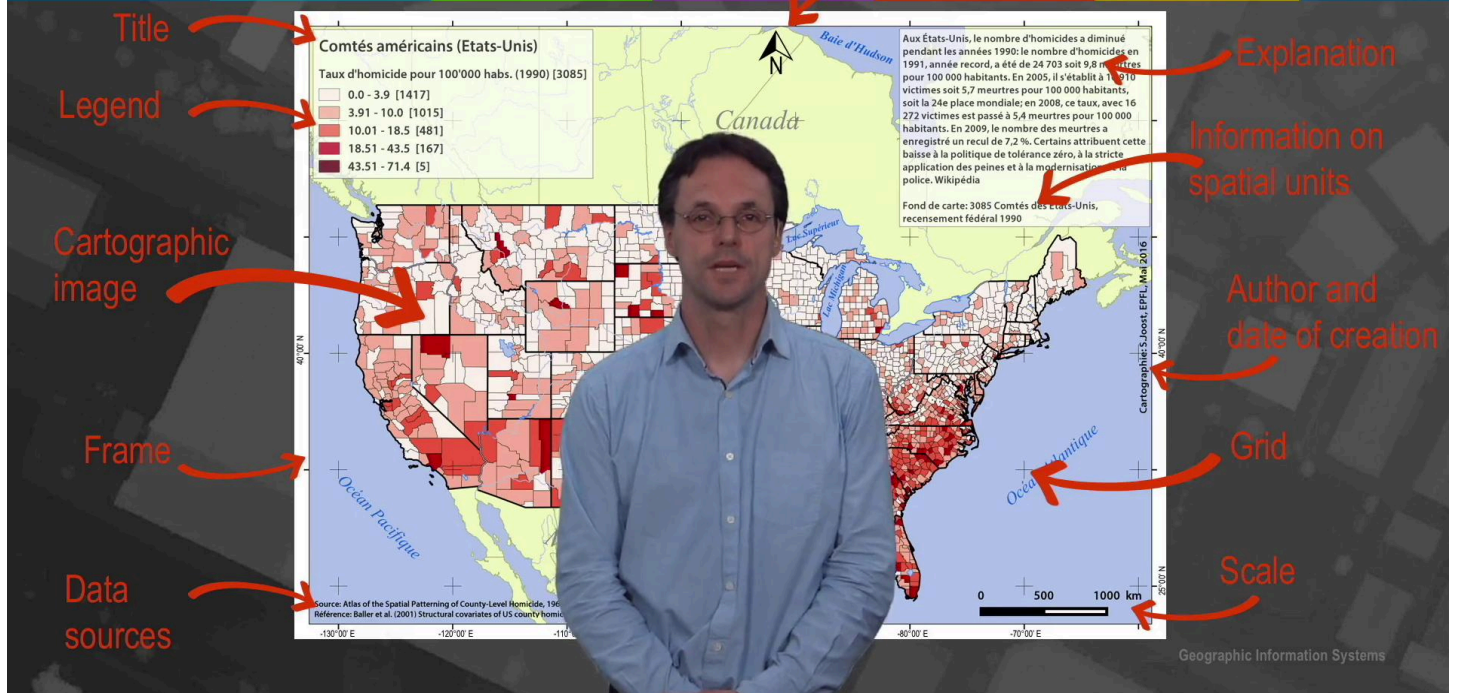
Notes

Summary



17m 09s

Map Components



Here is an example of a statistical thematic map and which contains the main components listed in the previous table. The title, the legend, the cartographic representation, the framework, the sources, the orientation, the scale, the light graticule is represented by crosses, the name of the author and the date of creation of the map, information on the spatial units used and a comment.

Notes

Summary



17m 46s

Fundamental Functions of a Map

- Jacques Bertin, The Semiology of Graphics, 1967
- Storage, Research, Communication

Storage	Research	Communication
Exhaustive	Exhaustive	Non-exhaustive
Non-memorisable	Memorisable (synthesis of information)	Memorisable
Complex representations of multiple images, limited by rules of legibility	Experimental representations created to discover a significant synthetic pattern	Simple representations that enable the effective delivery of a larger message
To be read	To be looked at	Read and looked at

Geographic Information Systems

Some geographical coordinates are also shown in the margin, for information: beyond the factual roles of the map named earlier, we must also mention the three major functions of the graphic representation, identified by Bertin. We will also talk about the functions of the graphic or of the cartographic image in our case, which are to record, process and communicate the information. The recording function is to provide a convenient and exhaustive inventory of the information. Its application results in reading maps whose content is not easy to remember. In fact it is a question of creating an artificial memory that avoids the effort of memorization. The processing function will implement processes of reduction of the information such as the classification or categorization, in order to obtain a synthetic scheme that is easier to memorize. We will proceed to a simplification whilst justifying the latter by the analysis, and use a given mode of representation. Finally, the communication function consists in giving the means to remember an information with the help of the visual memory. The information must be easy to remember and not exhaustive. It is necessary to produce a simple image which will record the information in the memory. Here is an example for each of these functions.

Notes

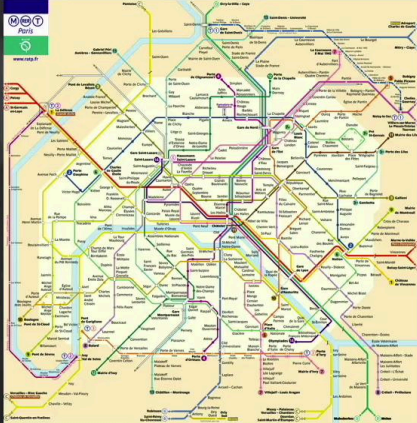
Summary



18m 16s

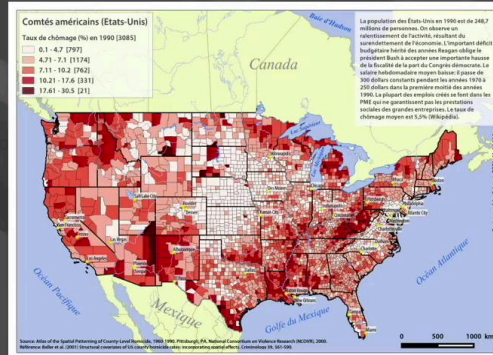
Map Functions

For store and taking inventory



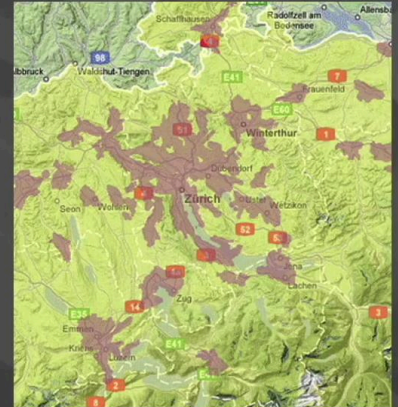
Subway or road networks
To be read

For research



Statistical Maps
To be looked at

For communication



Map of underserved zones
To be read and looked at

Geographic Information Systems

First a subway map to illustrate the recording and inventory of information. Then a statistical thematic map used to process the information. and finally a map that allows to communicate to a wide audience the areas covered by the mobile telephony network along the main highways in 2008 in the Zurich region, in Switzerland.

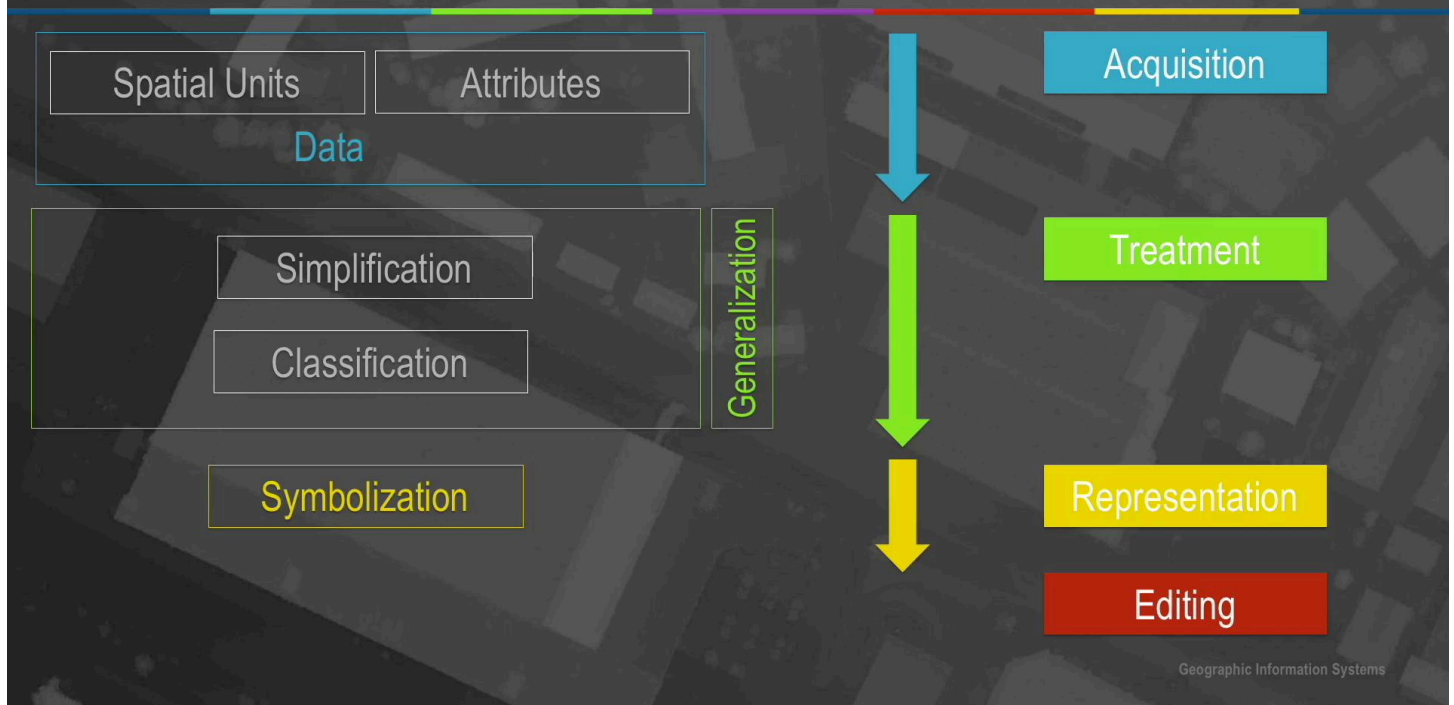
Notes

Summary



19m 41s

Process to Create a Thematic Map



We will conclude this lesson by presenting the process which enables to develop a statistical thematic map. Within the framework of a predefined research theme, it is initially necessary to acquire or select the necessary data. There are two levels of data, the spatial units that form the map background and the attributes that characterize the units in question. The raw attribute data can be used to create derived or combined variables. On this basis, we will process the information and create our reduced model of reality. We will simplify the system by selecting certain data and putting values into classes. It is a phase of generalization which is also part of the processing phase. Once processed, the information must be communicated by a graphic representation. We will then implement a system of conventional signs and symbols to make the map. Some authors speak of the implantation phase to designate the moment we transfer the thematic information in the space of the map background. Once the map is ready, there is another editing step during which we will improve or refine the graphic rendering. This phase may need to be performed in a third-party software specialized in graphic editing. In our case, you will see in the lessons that follow that we will be editing directly in a QGIS module.

Notes

Summary



20m 05s