IPROMO, 5th august 2008

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Looking (for and at) data on mountain issues: the contribution of Information Technologies and Remote Sensing

Index (main road)

- Basic concepts of Information Systems: Data, information, geographic data
- Geograhic Information Systems (GIS): basic concepts and evolutions
- How to look for or “I do not wish to reinvent the wheel”: a Spatial Data Infrasctructure to move data around
- What I’m looking: RS contribution to IT systems

Materials from:

- Spatial Databases, P. Rigaux, M. Scholl, A. Voisard, Morgan Kaufmann, 2002
- Principles of Geographical Information Systems, P. A. Burrough, R. A. McDonnell, 2004
- Lessons from the course of Sistemi inormativi III UniBG Ingegneria
- http://www.ucgis.org University Consortium for Geographic Information Science
- http://www.opengeospatial.org Open Geospatial Consortium OGC
- http://education.usgs.gov/common/lessons/gis.html Education resources of USGS
- http://inspire.jrc.it/reports.cfmDocument archive of INSPIRE and documents of http://www.opengeospatial.org/resource/cookbooks

Data … information …

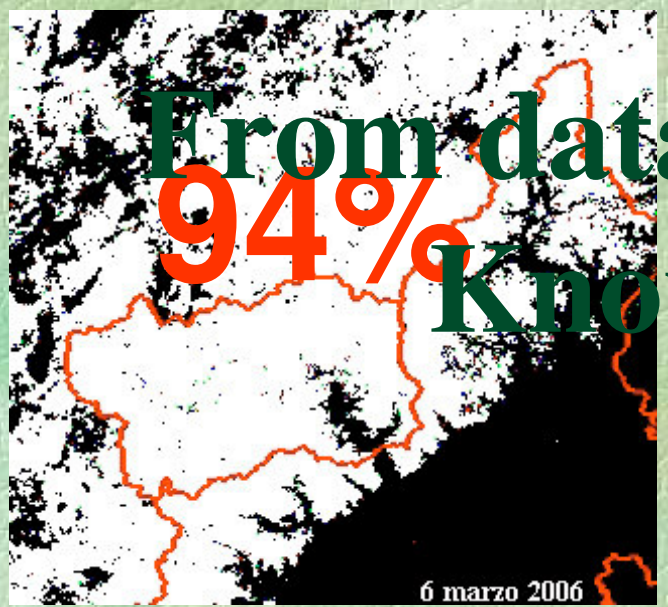
datum : element of information represented by symbols/values to be elaborated/interpreted

information : any aggregation of data the meaning of which is known (besides its values)

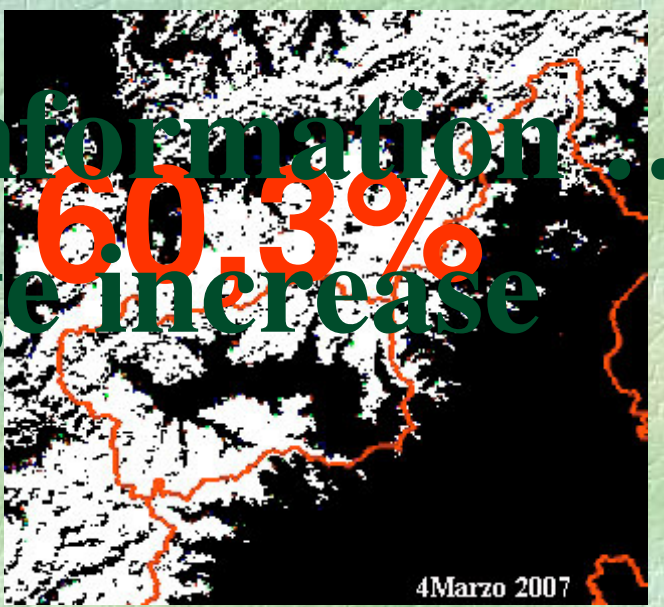
Data … information …

Classification of snow covered pixels in Valle d'Aosta

(white pixels=snow; black pixels=no snow)



2006
percentage of VdA surface covered by snow = **94%**
corresponding area = 3081 km2



2007
percentage of VdA surface covered by snow = **60.3%**
corresponding area = 1977 km2

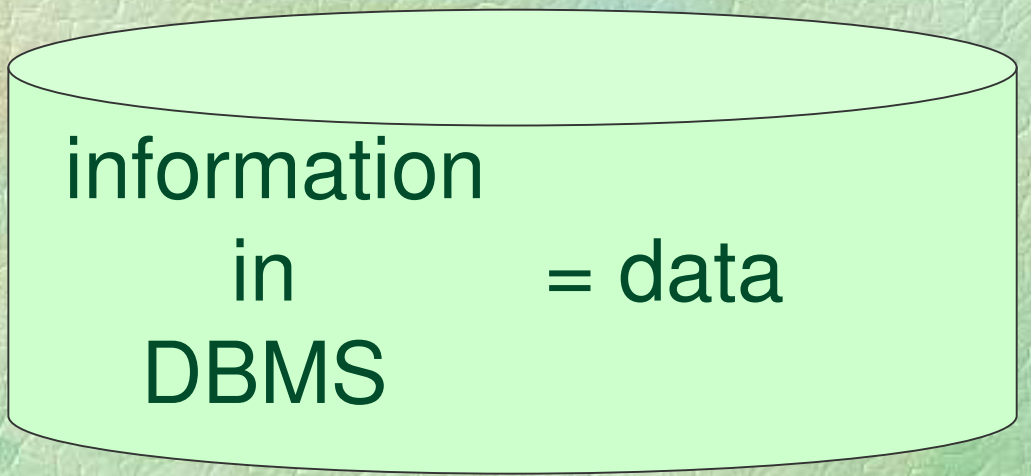
From data to information …

94% 60.3%

Knowledge increase

IT systems for data management

In data base management systems information is represented in a basic way through data



they need interpretation to enrich knowledge

IT systems for data management

In DBMS

data, codified facts:

Knowledge

requirements:

Who teaches in the course 'Scienza del suolo applicata'?
Which is his phone number?
Is there somebody who is expert in pedology at the University of Molise?
.....

data must be interpreted to enrich knowledge

IT systems for data management

DBMS :

to manage increasing amount of data related to traditional enterprise/organization applications

[database is a structured collection of records or data that is stored in a computer so that a computer program can consult it to answer queries]

From the 1960's

Applications: electronic catalogs, ticket reservation systems, bank account management systems, etc. etc.

IT systems for data management

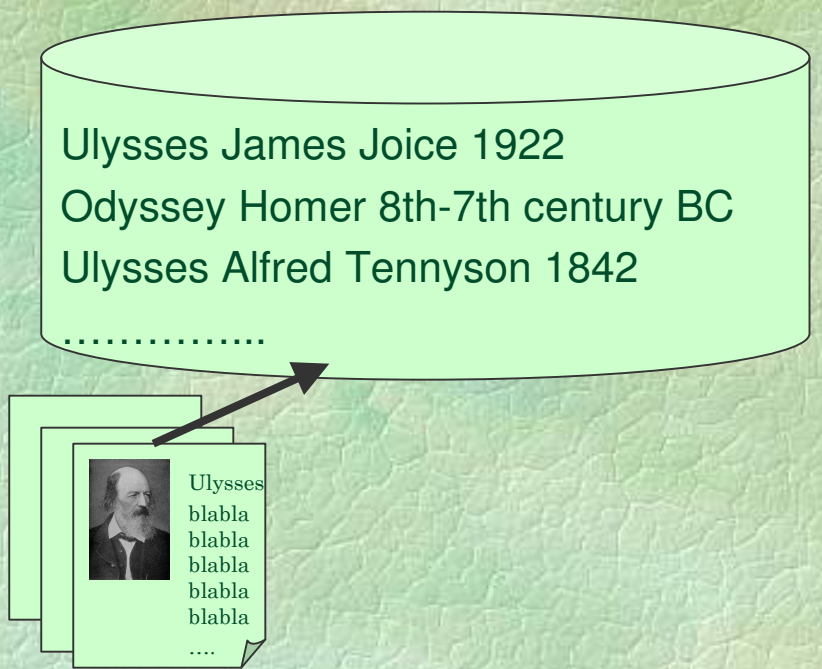
IRS (Information Retrieval System) :
to manage great amount of books, papers, texts ... in general unstructured documents (also images)

From the 1960's

Applications: electronic catalogs, library management, etc. etc., search engines on the WWW (also to search locations)

IT systems for data management

In IRS document surrogates:



Knowledge requirements:

Books titled ‘Ulysses’?
Books published after 1900?
Books about ‘troy’ and ‘ithaca’?
……

IT systems for data management

GIS (Geographic Information System) :
to manage archives of geographic data, i.e. data with a spatial extent and a geographic reference
and to allow their analysis

From the 1960's

Applications: cartography, environmental applications, risk evaluation, simulation and scenarios building, demography, resource location systems, land/urban planning, archaeology, tourism, etc. etc. etc.

IT systems for data management

Main data sources

- Topographic Mapping: national/regional agencies and private companies
- Military organizations (IGM)
- Space agencies (NASA, ESA, ASI)
- Environmental agencies (geology, hidrology, geography, pedology, biology, climatology, etc.)

Main data types

- Topographic Maps at various scales (1:100.000, 1:50.000, 1:25.000)
- Thematic Maps (Fogli CARG 1:25.000)
- Remotely sensed images (e.g. LANDSAT, orthophotos)
- Administrative and infrastructure maps
- Measures of environmental, historical, sociological, demographic … parameters

IT systems for data management

In GIS

data (DBMS) + coordinates + spatial representation

To meet knowledge requirements including geographic constraints!

Hotels next to a train station in the Northern area of Rome

Italian regions where forests cover more than 50% of surface

Percentage of forest fires that originated next to a road ……

GIS

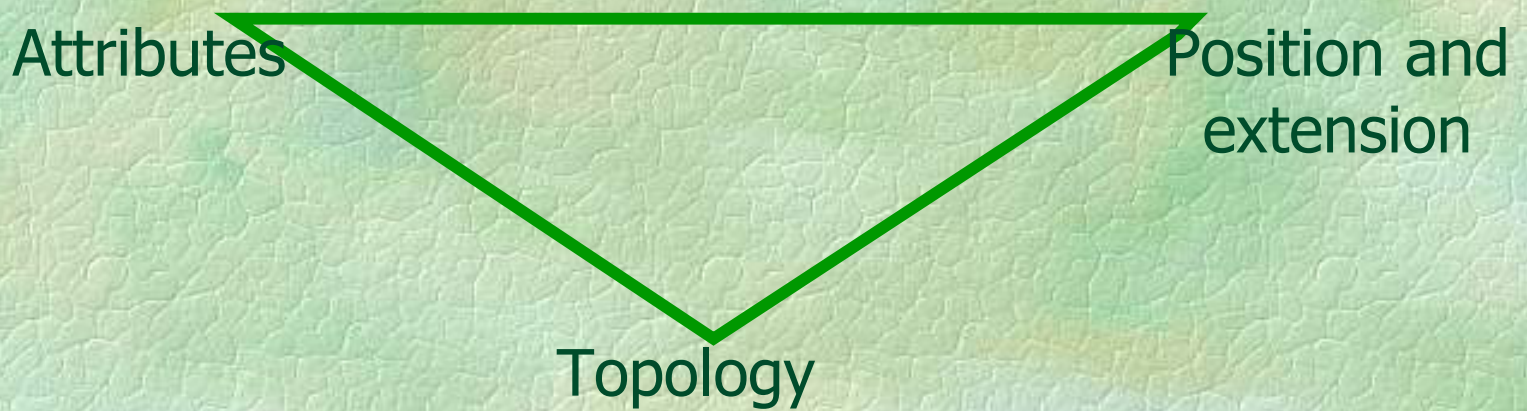
A GIS is a program able to capture, store, analyse and visually represent information with a geographic reference

Data with spatial reference and a spatial representation

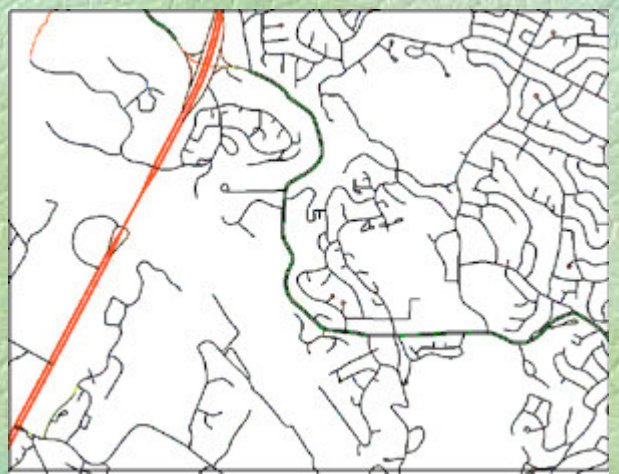
- co-ordinates x, y (z) (t)
- spatial reference system

GIS - components

- Data **Input**
- **Database Management System** for data representation, storage and retrieval
- Data **Output** and presentation
- Data **Trasformation** (update, modification, analysis) e.g.: scale conversion, re-projection, evaluation of feature values, fusion, etc
- **Interaction** with the user (user interface)



GIS - examples of information

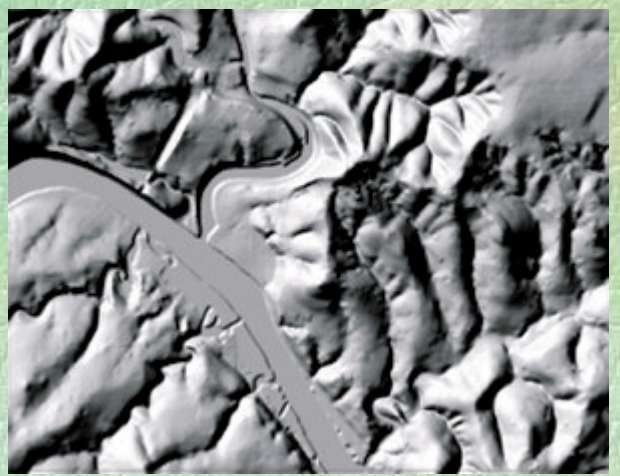


Information : road network in the region X
Data representation : graph of roads that are geometrically described as lines
it's a digital image

Information : hydrography of the region X
Data representation : graph of rivers/lakes that are geometrically described as either lines or polygons
it's a digital image

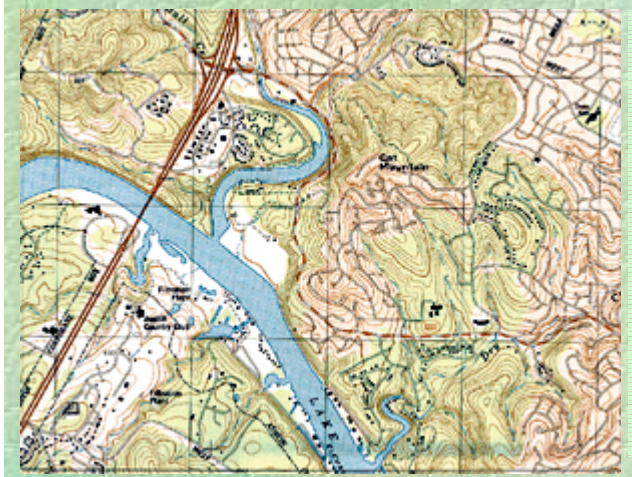
GIS - examples of information

Information : elevation of the region X
Data representation : graph of isohypses described as contours of lines following points whose elevation is constant
it's a digital image

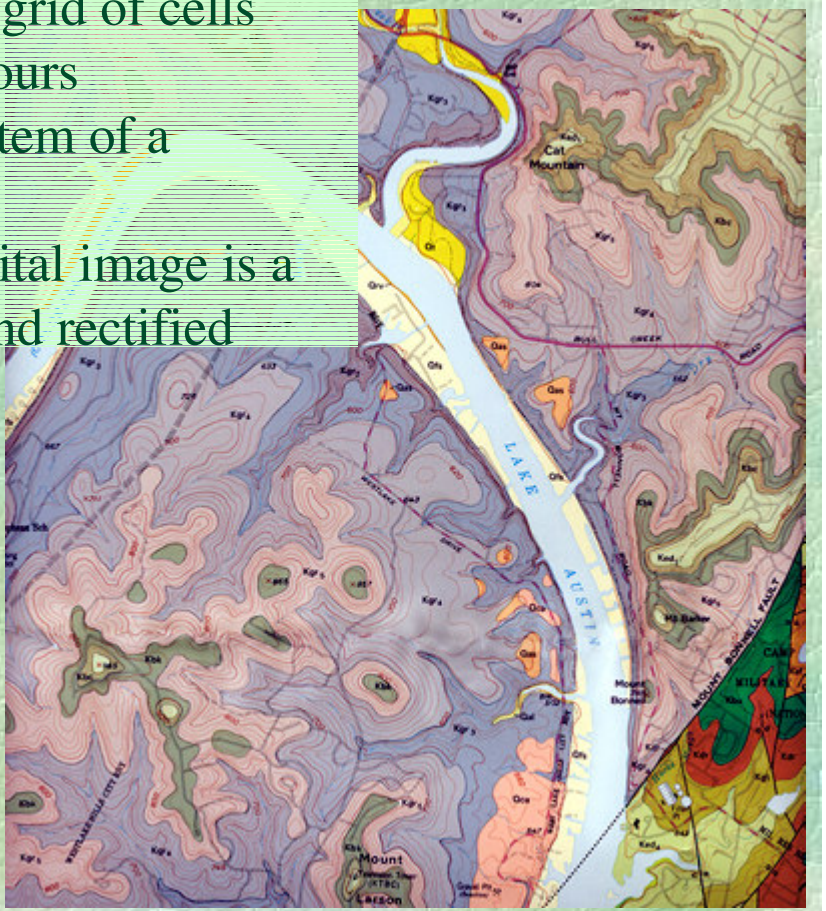


Information : elevation of the region X
Data representation : grid of cells whose third co-ordinate is the (re-scaled) value of elevation
it's a digital image

GIS - examples of information



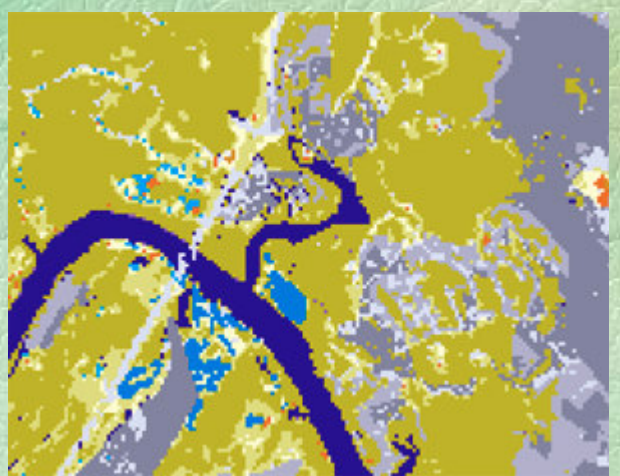
Information : map of the region X
Data representation : grid of cells whose values are colours corresponding to an item of a legend.
The source of the digital image is a paper map scanned and rectified



Information : geologic map of the region X
Data representation : polygons associated to values corresponding to an item of a legend
it's a digital image

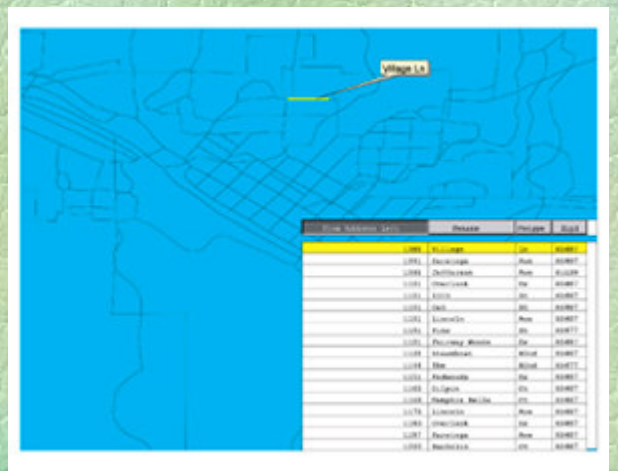
GIS - examples of information

Information : radiation emitted by the region X in the visible spectrum
Data representation : grid of cells whose third co-ordinate is the (re-scaled) value of radiance from the cell
The source of the digital image is a sensor on a satellite

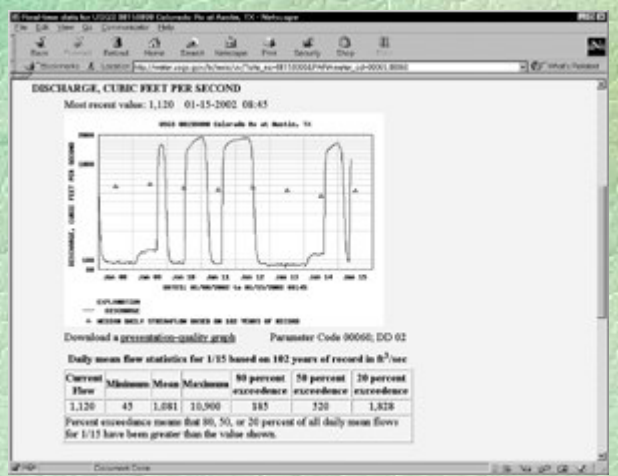


Information : land use in the region X
Data representation : grid of cells whose values are colours corresponding to an item of a legend
The source of the digital image is the above satellite image

GIS - examples of information

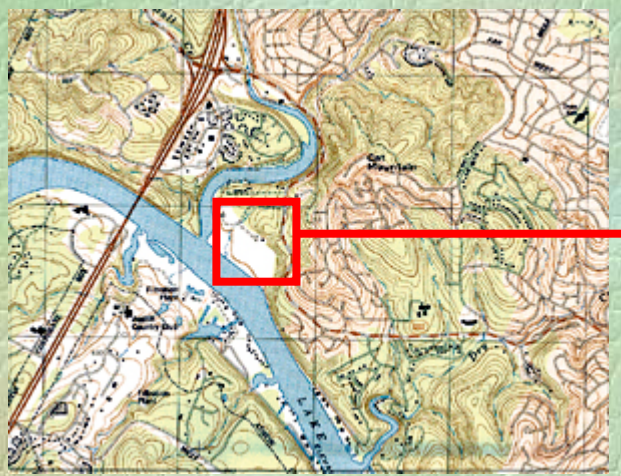


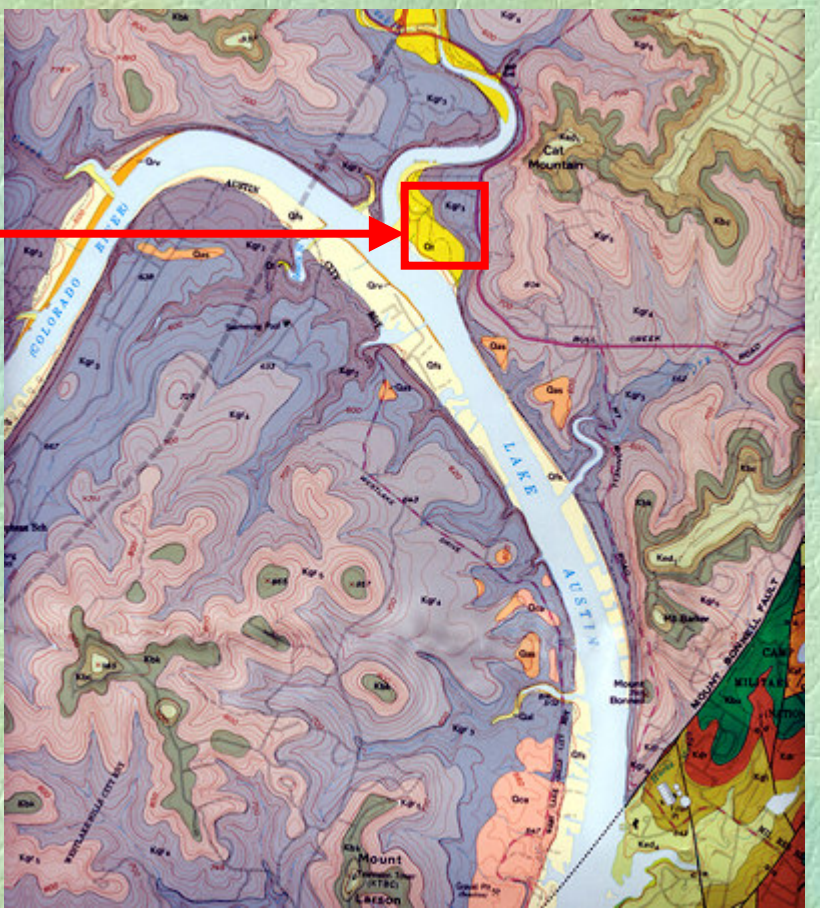
Information : ownership of land parcels in the region X
Data representation : digital image with the polygons associated to each parcel + table of data; each record contains the data regarding a polygon



Information : runoff trend of the main river in the region X
Data representation : graph of the river runoff at a gauging station (runoff values at a known location along time)

GIS - relating information

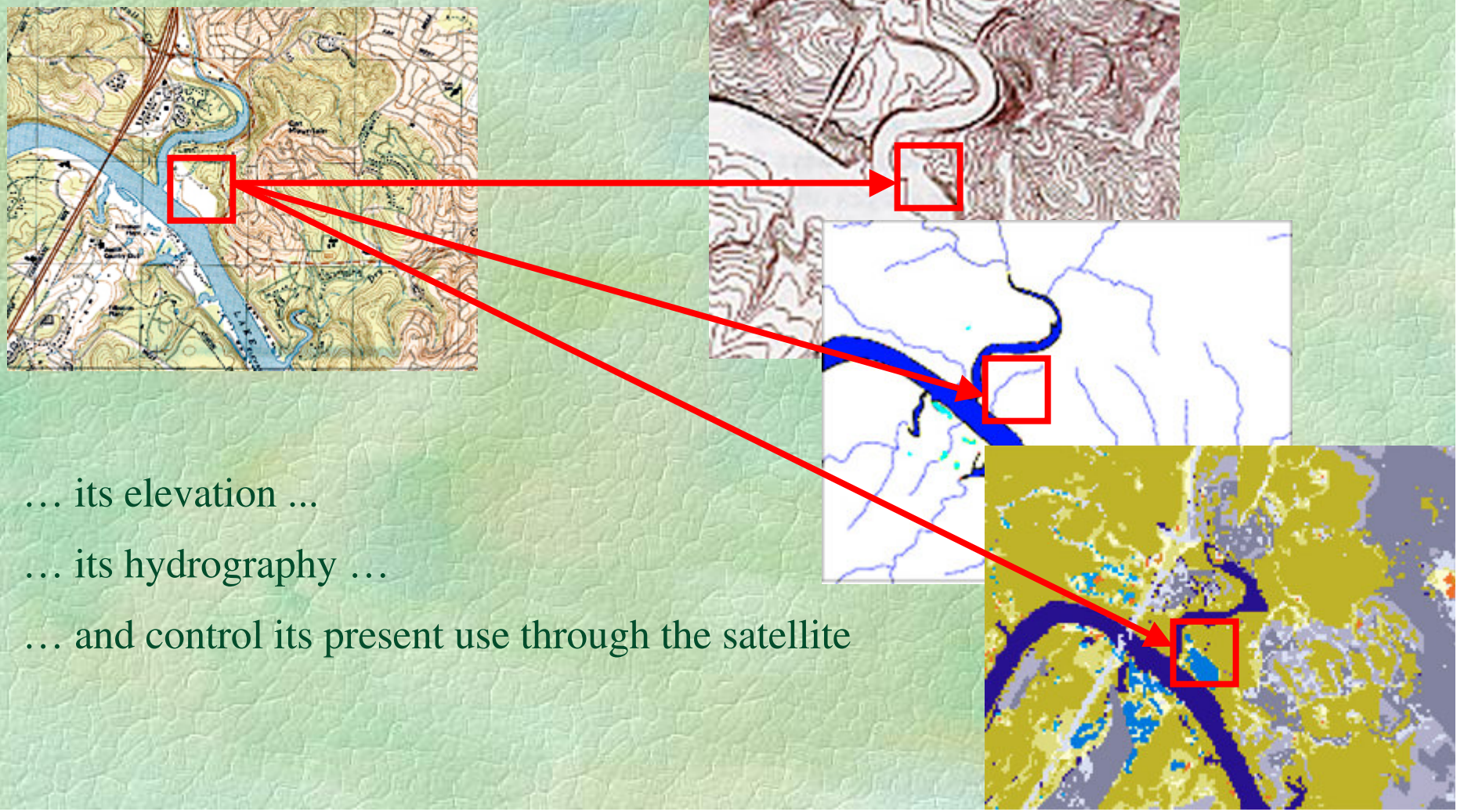




A GIS relates what is present in its stored data :
maps (layers) are connected each other through the coordinate association

-> ex. if we select an area in the cartography layer, we can know … its geologic composition (geology layer) …

GIS - relating information

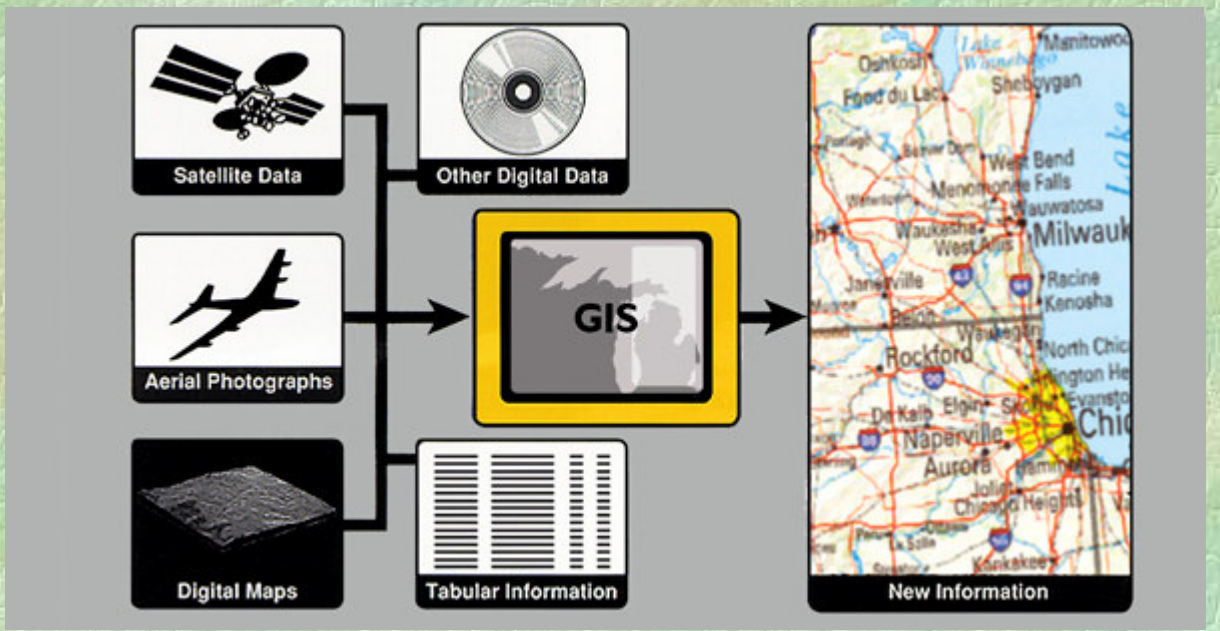


… its elevation ...

… its hydrography …

… and control its present use through the satellite

GIS - a tool to integrate information



A GIS is a powerful tool to connect heterogeneous data related to the same area to create new knowledge that can be expressed as results of queries, maps, graphs, ...

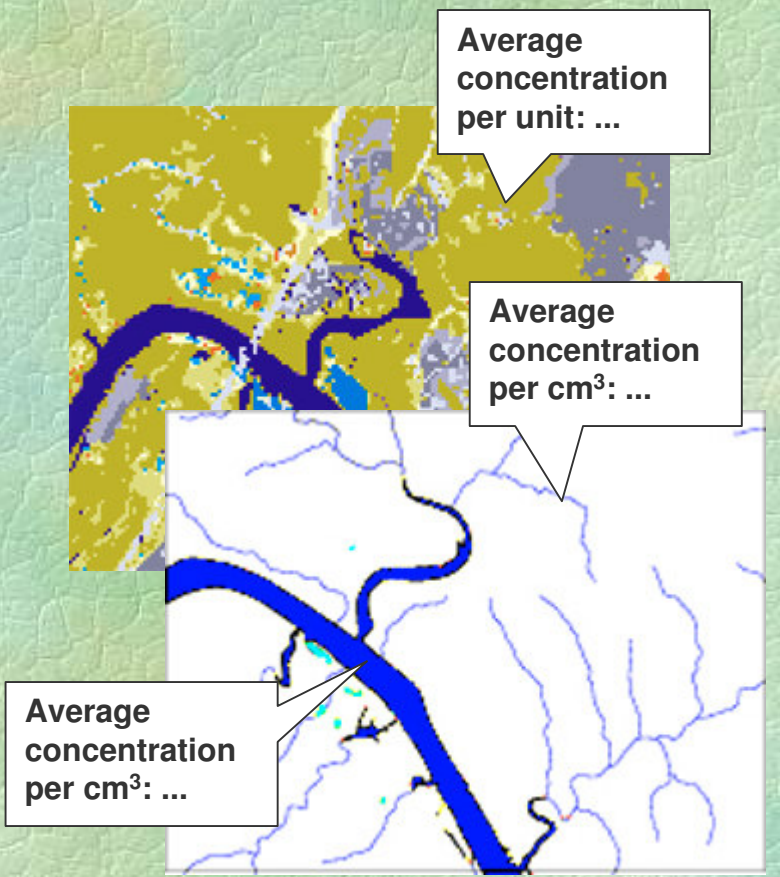
GIS - a tool to integrate information

A simple example for prediction purpose

A GIS can enrich data on land use storing the amount of fertilizer used in each field unit

The spatial intersection of land use with hydrography allow to find intersections of field units and rivers

A suitable model can compute the amount of nutrients carried by each river and their total amount in the main streams

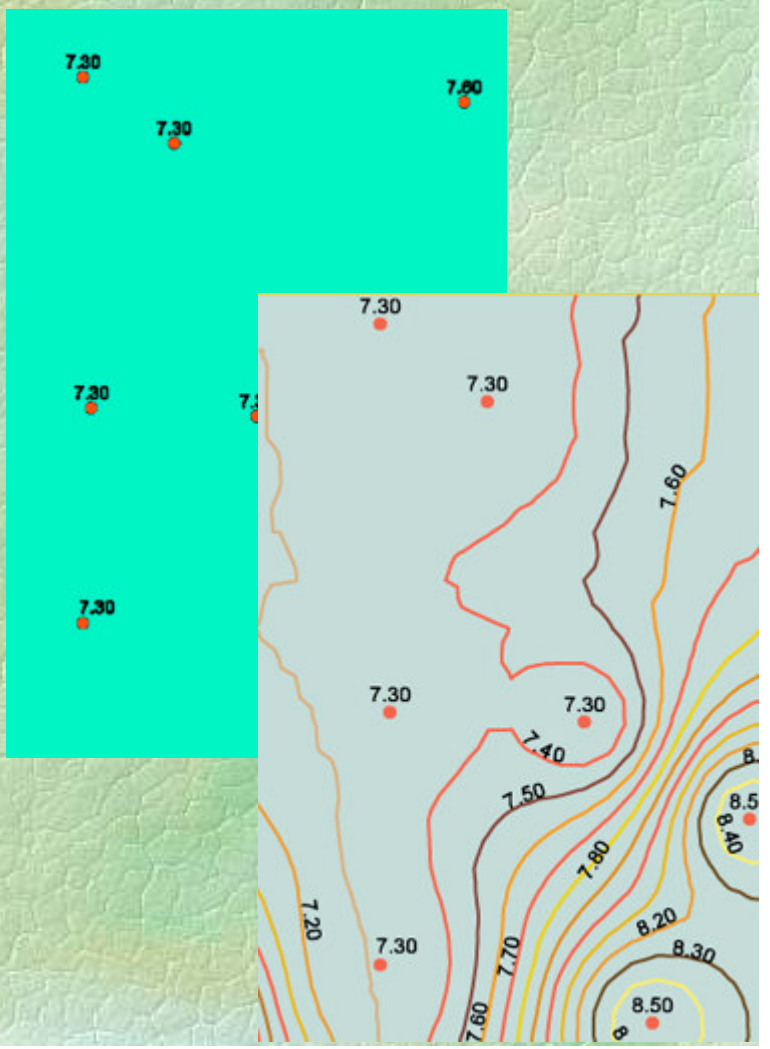


GIS - a tool to generate new information

Source of data: values measured by field sampling in an area of interest

A GIS is able to generate polygons whose contours border areas where measured values are constant. The result is a new layer where each contour highlights a change in the value. Value distribution can be done through different methods based on different models.

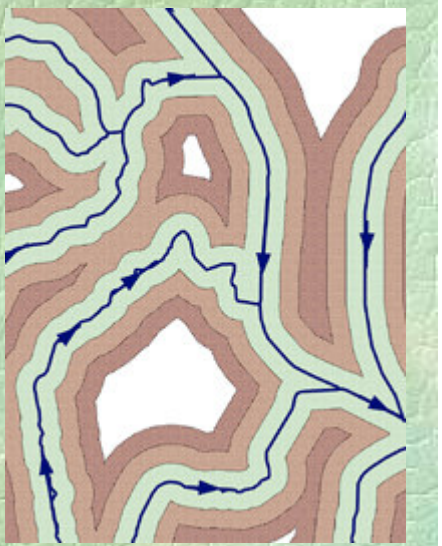
The new layer can be stored and used for further analysis ...



GIS - a tool to generate new information

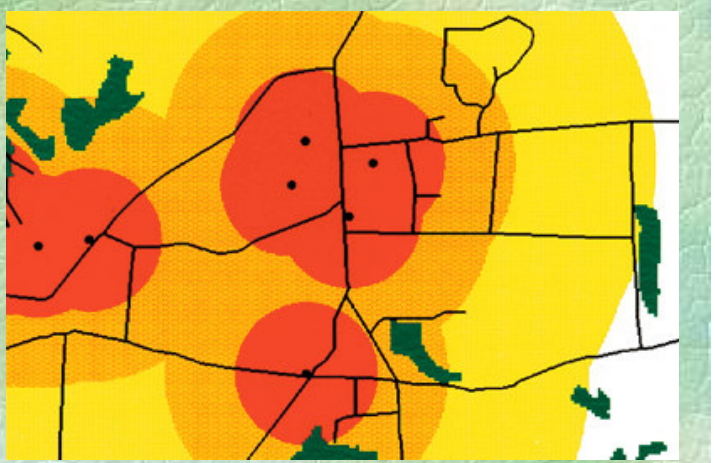
GIS allow analysis requiring to verify

- adjacency (what is next to x?)
- inclusion (what is inside y?)
- proximity (which is the distance of x and y?)



Some examples of queries:

- Are there stables next to the spring?
- Are there roads whose distance from the spring is no more than 1 km?



A GIS is able to generate maps that visually emphasise metric and topologic relations

GIS - a tool to integrate information

Complex examples:

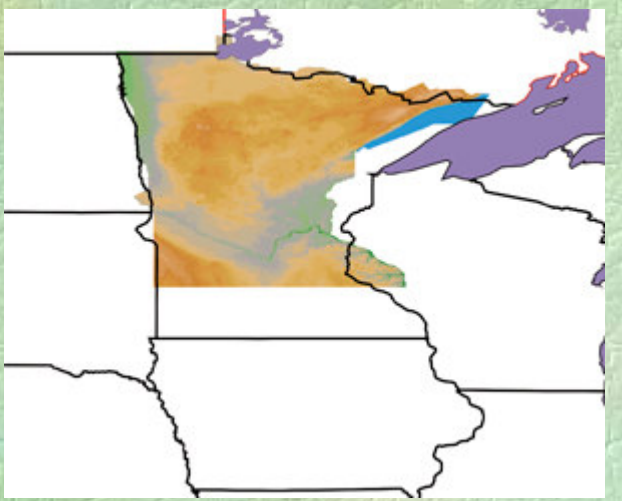
see further slides

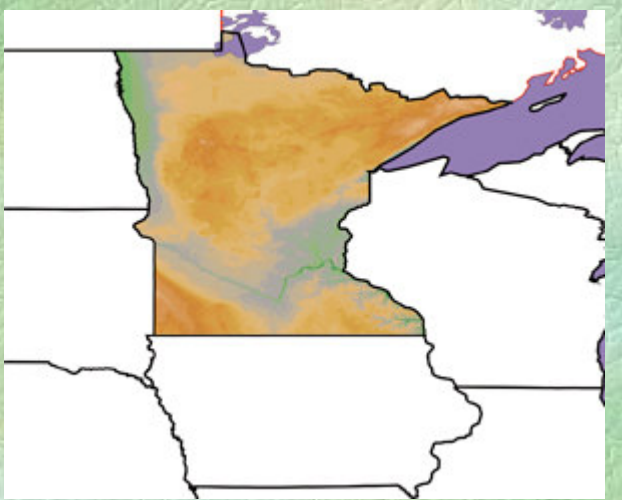
GIS - data are an issue

Data in a GIS must be ‘comparable’

Projection: geometric method to transfer 3D on the surface of Earth (which is not flat) to a 2D representation.
Different methods are available and the choice depends on purpose, conventions, ... (ex: a projection preserving shapes does not preserve distances)

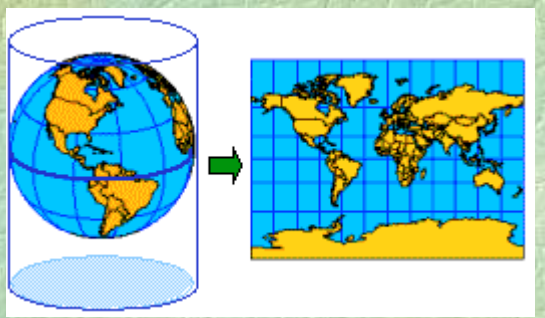
Operative GISs have facilities to change projections



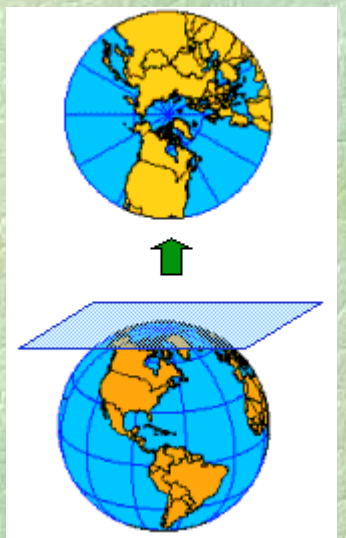


GIS - data are an issue

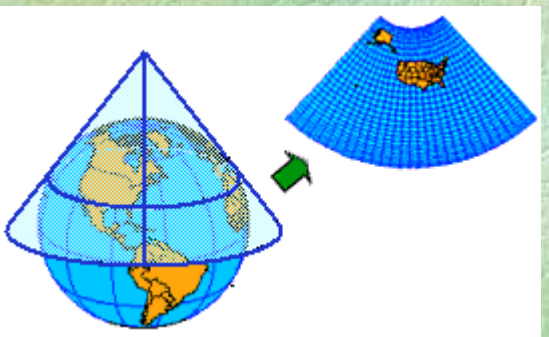
Cylindrical Projection



Planar Projection



Conical Projection

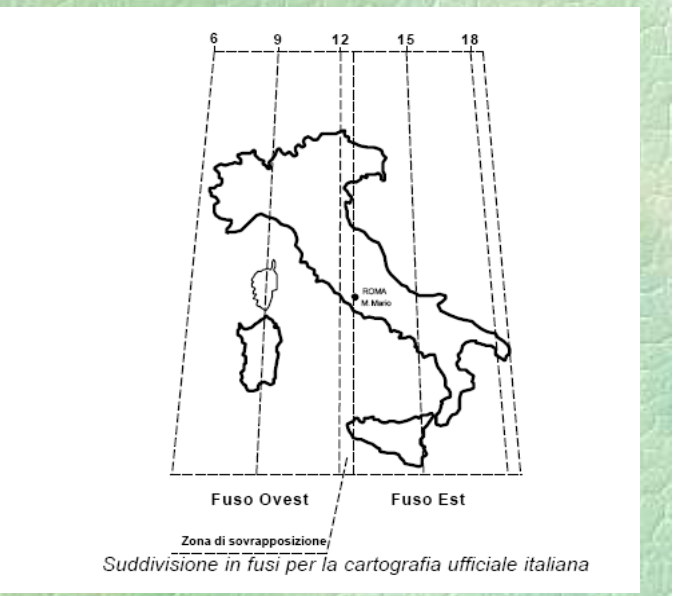


http://geography.about.com/cs/mapprojections/index.htm

GIS - data are an issue

Official Italian cartography adopts the system **Gauss-Boaga** (since 1940) with two time zones:

- West time zone and East time zone next to the time zones 32 and 33 UTM (Universal Transverse Mercator) (9° and 15° east long)
- local meridian Monte Mario, Rome



Suddivisione in fusi per la cartografia ufficiale italiana

Note tratte da:
Regione Piemonte
Manuale della Carta
Tecnica Regionale Numerica

GIS - other data issues

Co-ordinates

A spheric co-ordinate system is used to locate and measure geographic objects on the Earth

Co-ordinates are expressed as degrees of latitude and longitude. Values are either positive or negative

Measures are in degrees, minutes and seconds (DMS) or in decimal degrees (DD). By example 55°30'00" is the same value of 55.5°

The EC suggest ETRS89 coordinate reference system has

established itself as a pan-European system

http://crs.bkg.bund.de/crs-eu

GIS - data are an issue

Sometimes geometry prevents understanding:

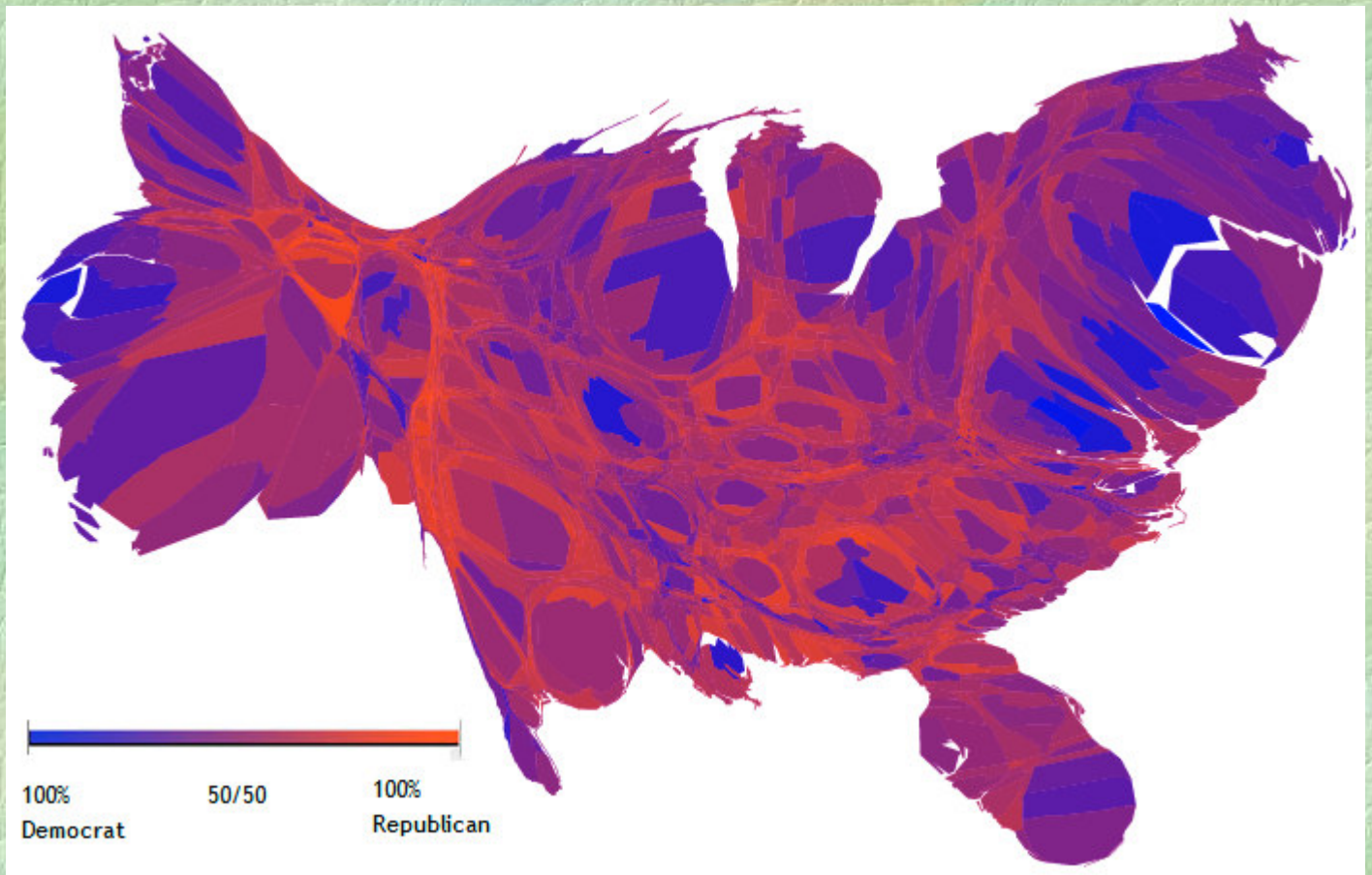
the cartograms

GIS - cartograms

A cartogram is a map in which area is not preserved. Instead, another thematic mapping variable like travel time or Gross National Product is substituted for land area. In other words, the geometry or space of the map is distorted in order to convey the information of this alternate variable. There are two main types of cartograms: area and distance cartograms. An area cartogram is sometimes referred to as value-by-area map or an isodemographic map. The latter particularly for a population cartogram, which illustrates the relative sizes of the populations of the countries of the world by scaling the area of each country in proportion to its population; the shape and relative location of each country is retained to as large an extent as possible, but inevitably a large amount of distortion results.

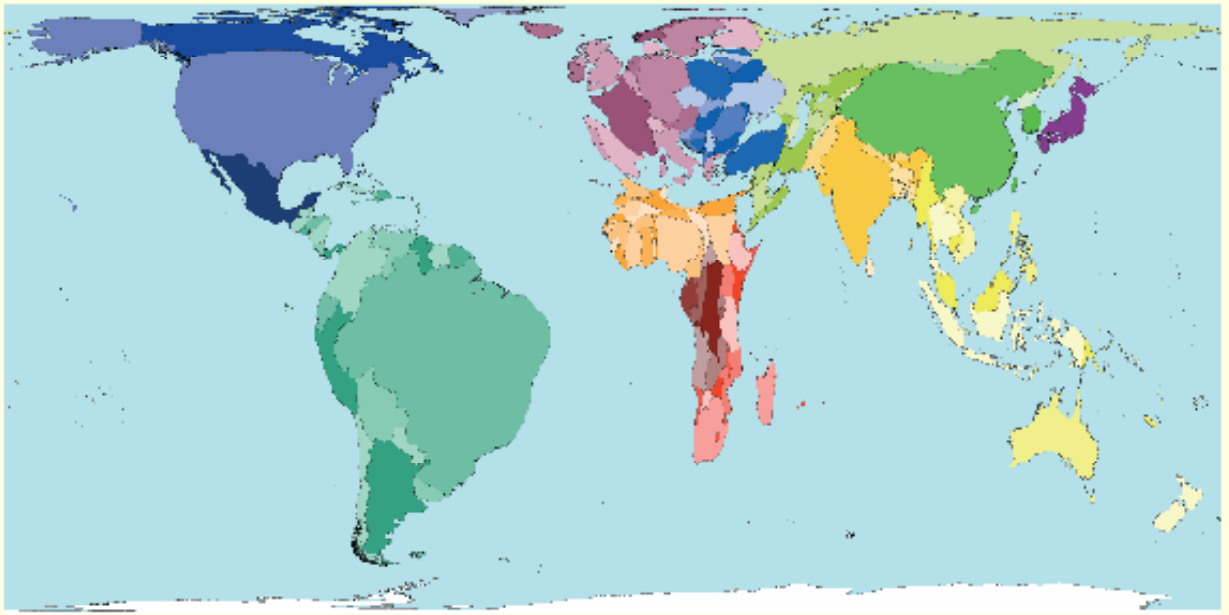
GIS - cartograms

A cartogram depicting popular votes in the 2004 US Presidential election, in which the sizes of counties have been rescaled according to their population.
Created by Michael Gastner, Cosma Shalizi, and Mark Newman of the University of Michigan.



Biocapacity

Produced by the SASI group (Sheffield) and Mark Newman (Michigan)



Biocapacity measures how biologically productive land is. It is measured in 'global hectares': a hectare with the world average biocapacity. Biologically productive land includes cropland, pasture, forests and fisheries. 16% of the world's biocapacity is in Brazil.

The biocapicity of a territory is affected by physical conditions and people's actions. A pertinent example of this is Iraq, the Mesopotamian marshes were once part of the fertile crescent. Much of this marshland has been drained and become desert. Trade sanctions and social upheavals also reduce people's ability to use land productively. Iraq's land is now estimated to be the least productive in the world.

Territory size shows the proportion of all biocapacity that is found there.

Land area

Technical notes

- Data are from the WWF (Worldwide Fund for Nature) International and Institute of Zoology.
- "Biocapacity is measured in global hectares. One global hectare is an area that has the world average biologically productivity of one hectare.
- See website for further information.

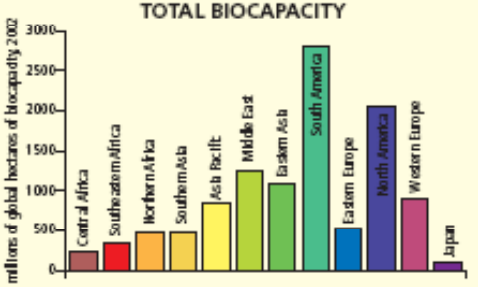
HIGHEST AND LOWEST BIOCAPACITY

Rank	Territory	Value
1	Malta	699
2	Mauritius	687
3	Germany	429
4	Denmark	427
5	United Kingdom	403
6	Luxembourg	378
6	Belgium	378
8	Czech Republic	362
9	Netherlands	357
10	France	351

Rank	Territory	Value
191	Botswana	14.4
192	Mali	13.1
193	Afghanistan	11.2
194	Niger	11.1
195	Somalia	11.0
196	Saudi Arabia	10.5
197	Namibia	10.5
198	Algeria	8.3
199	Libyan Arab Jamahiriya	3.1
200	Iraq	1.8

*biocapacity in global hectares per 100 hectares, 2002 **

TOTAL BIOCAPACITY



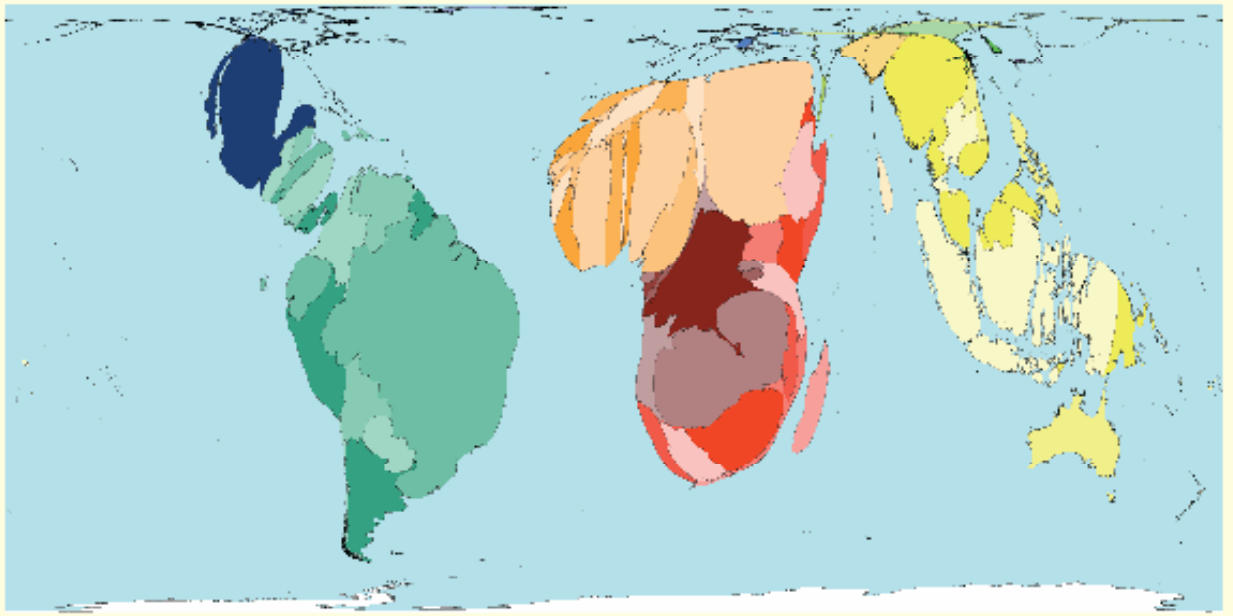
"... land is 'not only' the ground, it is 'not only' a means of production and it is 'not only' the material reality that one knows ..."

Claudia Briones, 2006

www.worldmapper.org © Copyright 2006 SASI Group (University of Sheffield) and Mark Newman (University of Michigan)

Forest Loss

Produced by the SASI group (Sheffield) and Mark Newman (Michigan)



If the net forest loss of all territories between 1990 and 2000 is summed, 31% occurred in South America, and 21% was in Asia Pacific. Worldwide, territories with net forest loss lost 1.33 million km^2 of forest over this ten year period. Despite this, South America was the region with the largest forested area in the world in 2000. The more forest area there is, the more it is possible to lose.

Japan is unexceptional, having neither forest loss nor forest growth from 1990 to 2000.

The area of Africa covered by forest was reduced by 550 000 km^2 in the 1990s. This includes the loss of forests that covered 11.4% of Zambian land.

Territory size shows the proportion of worldwide net forest loss that occurred there between 1990 and 2000.

Land area

Technical notes

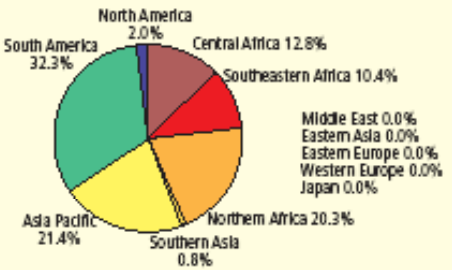
- Data are from the World Bank's World Development Indicators.
- Forest loss is the change in forest area between 1990 and 2000.
- Forest area is area under natural or planted stands of trees, whether productive or not.
- *The graph shows net forest loss in each region.
- See website for further information.

MOST FOREST LOSS

Rank	Territory	Value	Rank	Territory	Value
1	Belize	15.6	11	Malawi	7.5
2	Zambia	11.4	12	Indonesia	7.2
3	Nicaragua	9.7	13	Malaysia	7.2
4	Samoa	8.8	14	Panama	7.0
5	Cote d'Ivoire	8.3	15	Benin	6.3
6	Zimbabwe	8.3	16	Rwanda	6.1
7	Saint Lucia	8.2	17	Burundi	5.7
8	Liberia	7.9	18	Nepal	5.5
9	Myanmar	7.9	19	Sri Lanka	5.4
10	Guinea-Bissau	7.7	20	Dominica	5.3

forest loss as a percentage of land area

WORLD FOREST LOSS DISTRIBUTION*

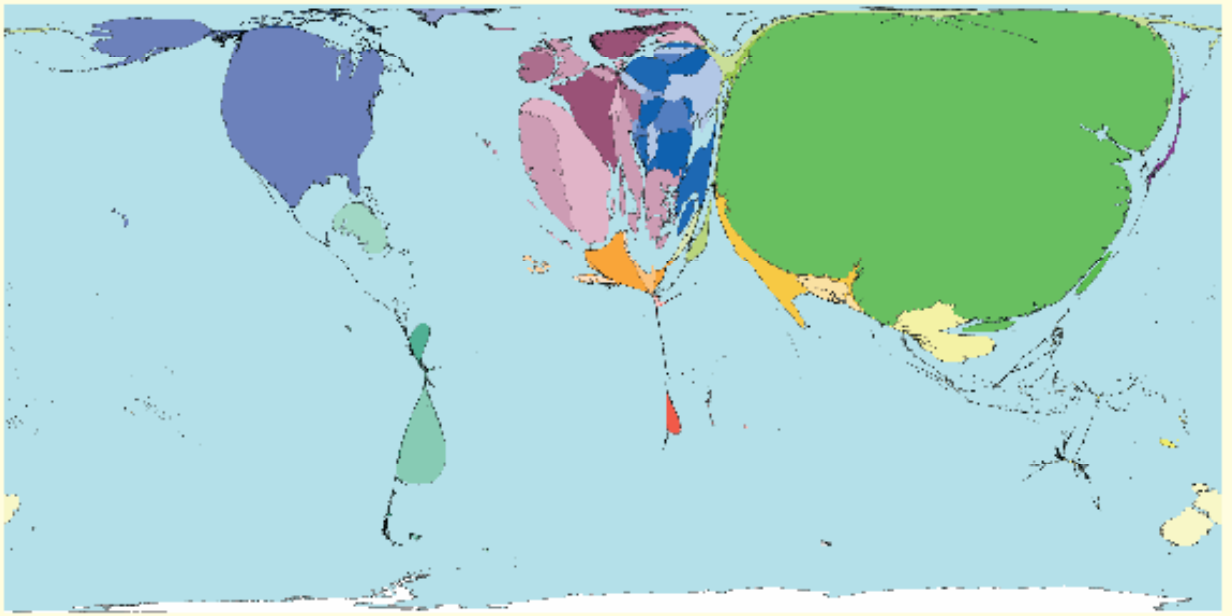


"Indonesia is blessed with some of the most extensive and biologically diverse tropical forests in the world. But the tragedy is that Indonesia has one of the highest rates of tropical forest loss in the world." E.G. Togu Manurung, 2006

www.worldmapper.org © Copyright 2006 SASI Group (University of Sheffield) and Mark Newman (University of Michigan)

Forest Growth

Produced by the SASI group (Sheffield) and Mark Newman (Michigan)



The territory with the most forest expansion between 1990 and 2000 was China, which gained 181 000 km^2 over the ten year period. China is also the territory with the largest population living there. The forest growth in the United States was the second largest increase, but this was only a fraction of the increase in China, at 39 000 km^2.

Unsurprisingly the most absolute forest growth has occurred in the large territories mentioned above. However the biggest increases in forest as a percentage of land area were in smaller territories such as Cape Verde, Liechtenstein and Portugal.

Worldwide there is net forest loss.

Territory size shows the proportion of worldwide net forest growth that occured there between 1990 and 2000.

Land area

Technical notes

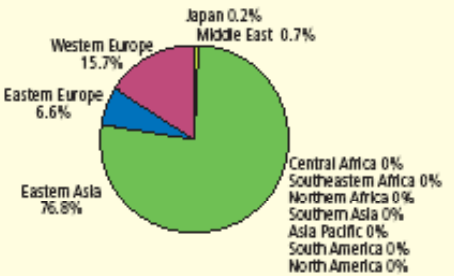
- Data are from the World Bank's World Development Indicators.
- Forest growth is the change in forest area between 1990 and 2000. Forest area is area under natural or planted stands of trees, whether productive or not.
- *Graph shows net forest growth in that region.
- **Hong Kong and Taiwan rank 15th, these were estimated values so are not shown in the table.
- See website for further information.

MOST FOREST GROWTH

Rank	Territory	Value	Rank	Territory	Value
1	Cape Verde	12.41	11	Israel	2.30
2	Liechtenstein	6.25	12	China	1.94
3	Portugal	6.23	13	Bulgaria	1.84
4	Cyprus	5.74	14	Spain	1.72
5	Gambia	4.50	17	Viet Nam	1.59
6	Swaziland	3.37	18	New Zealand	1.46
7	Uruguay	2.86	19	Bangladesh	1.27
8	Cuba	2.52	20	France	1.12
9	Ireland	2.47	21	Switzerland	1.09
10	Greece	2.33	22	Norway	1.01

*forest growth as percentage of land area***

WORLD FOREST GROWTH DISTRIBUTION*



"One generation plants the trees; another gets the shade." Chinese proverb, date unknown

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GIS - other data issues

Data model : **the space $\Re^2$ must be represented in a discrete way.**
geographic areas can be represented as a regular grid (**raster model**). This representation is suitable for operations between images but makes harder spatial transformations (scale, rotations, ..) and countor detection. Raster images may require huge memory space

On the other hand, the **vector model** represent geographic pieces of reality as geometric elements (points, lines, polygons) Vector images are suitable for spatial transformations and contours are well defined. Vector repres. is concise

1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	3	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	1	2	2	2	3	3	3
1	1	1	1	1	1	3	3	3	3
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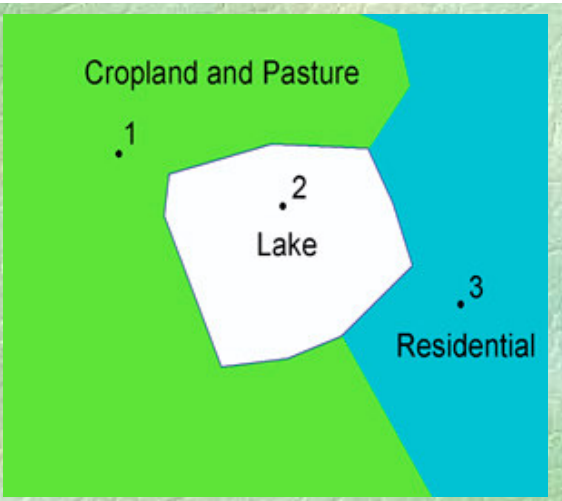


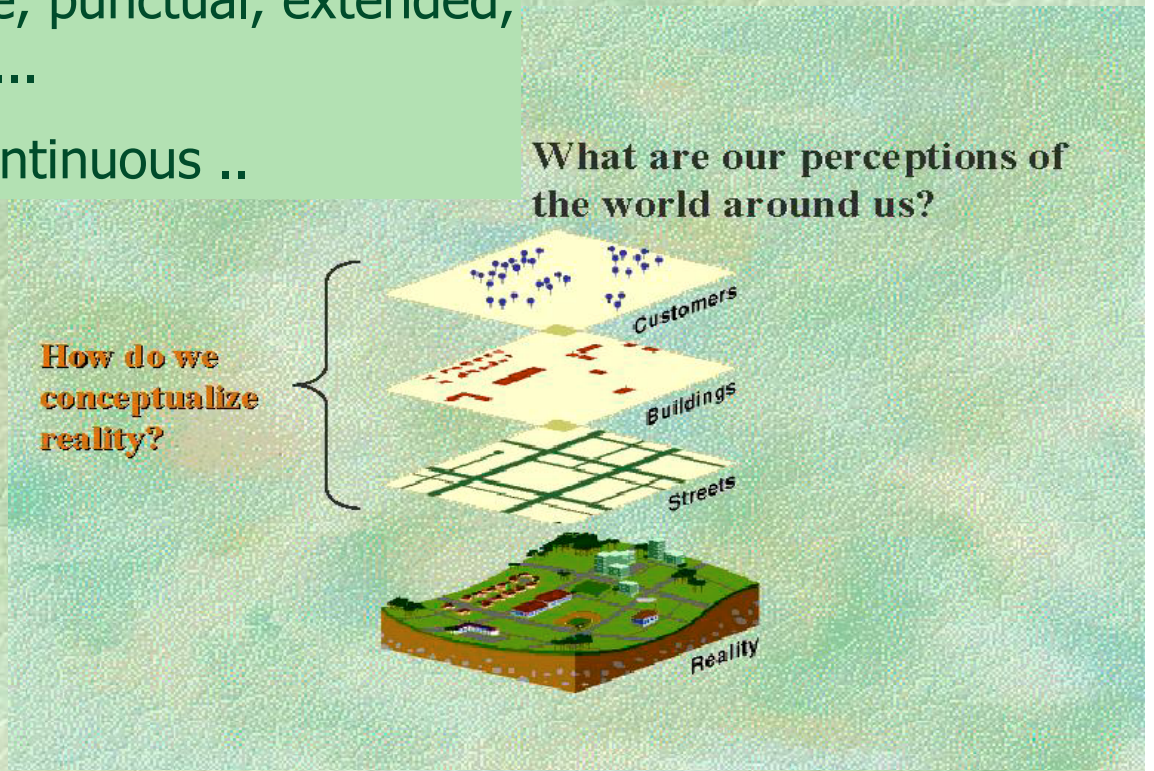
GIS - other data issues

Data model is guided by:

- Data source (e.g. RS images)
- Objects are discrete, simple, punctual, extended, composed, interconnected, ...
- Variation of attributes is continuous ..

NB:

- Scale!!!
- Purpose, application, operations



Spatial data on WWW

Web mapping designs, implements, generates, delivers and shares maps on the WWW (PCs, PDAs, mobile phones, ..)
ex. Google Earth

If the (mobile) web maps also display context and location sensitive information, such as points of interest, the term **location based services** is frequently used

In **WebGISs** it is possible to analyse, process, elaborate geodata via the WWW

Web mapping open new perspectives in distributing and sharing geographic data (up to date info, no intermediaries, ...)

many new issues (technological/conceptual/legal)

Spatial data on WWW

new issues

technological: image dimensions, screen space and resolution, bandwidth, interaction, reliability of the network, immature development tools, …

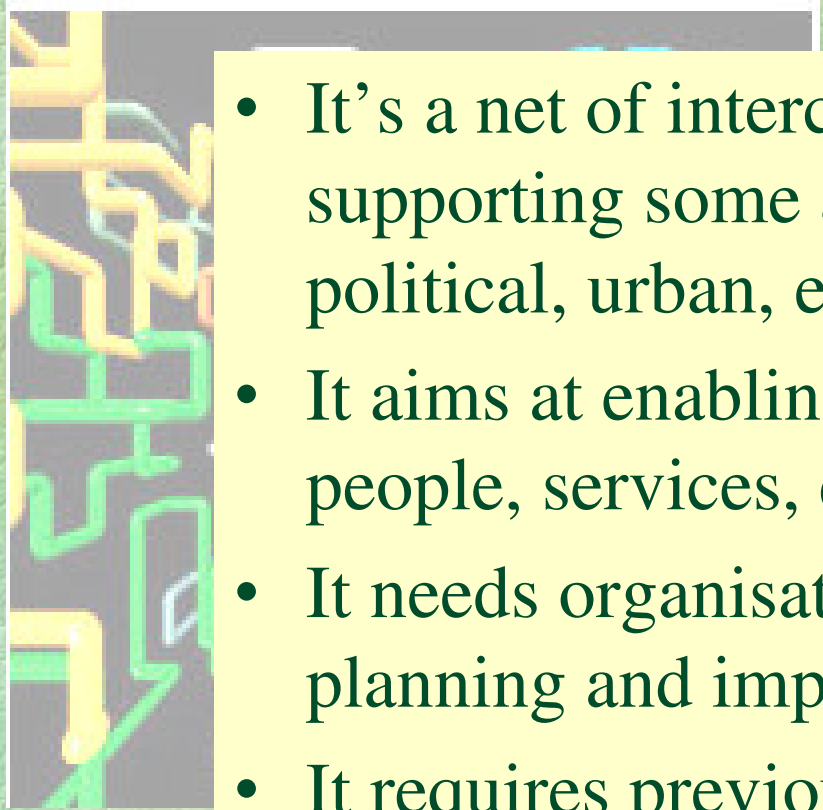
conceptual: data model, modelling/representation standards, reference systems, co-ordinates, usability, accuracy/quality, …

legal: copyright, security, privacy, ...

Spatial Data Infrastructure (SDI)

National Research Council of Italy
IREA Remote Sensing Department

What is an Infrastructure?



- It's a net of interconnected elements supporting some activity, e.g. social or political, urban, economic, military, …
- It aims at enabling the flow of goods, people, services, etc.
- It needs organisations in charge of its planning and implementation
- It requires previous and long-term investment of costs, engagements, and maintenance

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Example: road infrastructure

Technologies: building of the road network

Strategies: planning and maintenance at multiple levels (local, regional, …)

Standards: system of signals, code of signals, road information, ...

Guarantee access to the road network

Optimize capacities of available networks

Guarantee efficiency and safety of roads

National Research Council of Italy
IREA Remote Sensing Department

Spatial data sharing: an important activity

Geographic information is fundamental i
many important fields of human/soci

- Environment management and
- Security and logistics
- Social and health d
- Service imp
- ...

We need an infrastructure

information
accessible,
wner must be easily identified,
cost (if any) must be clear,
characteristics must be transparently evaluated,
suitability to the user management process must be analysed,
....

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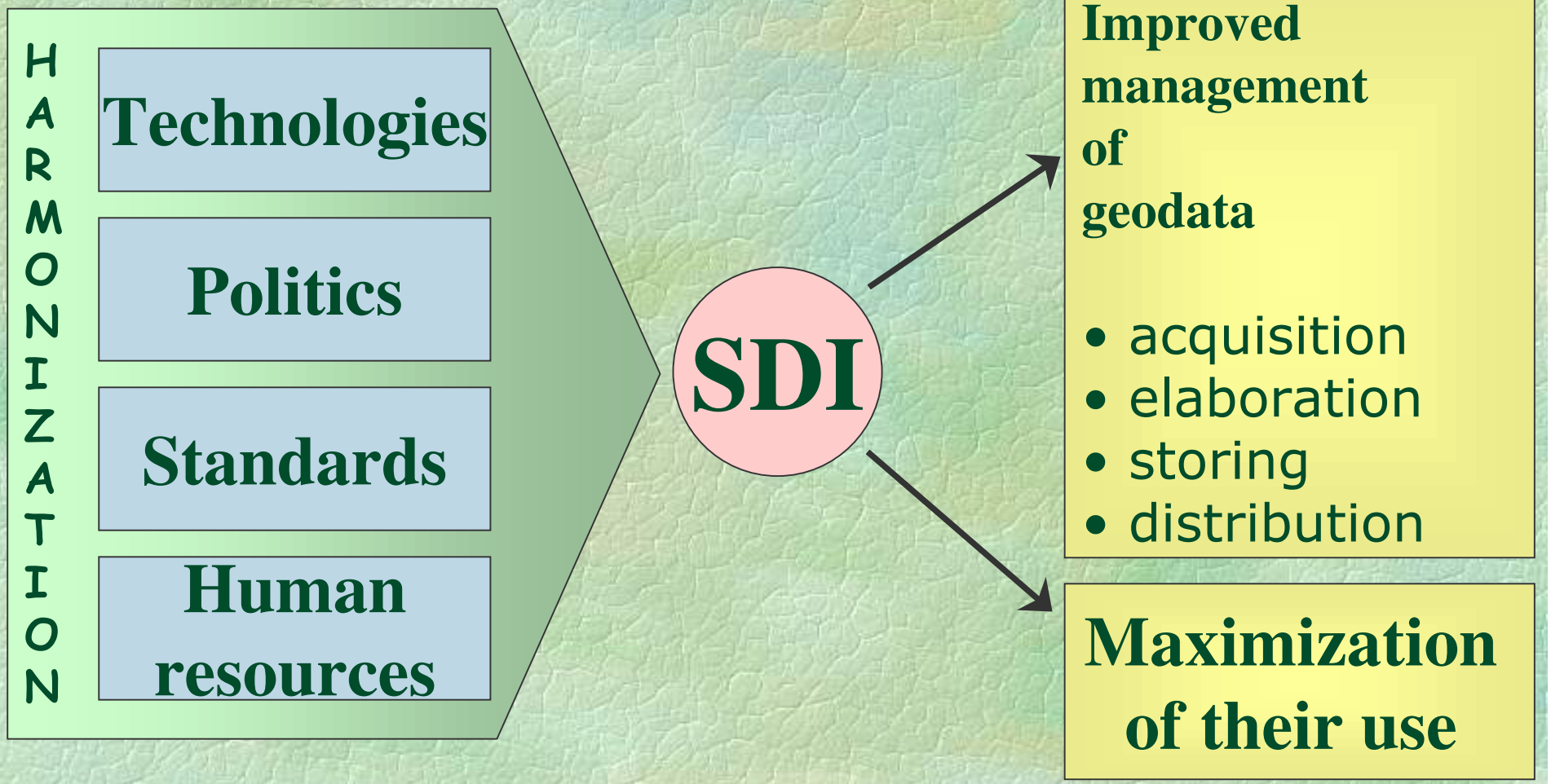
IREA Remote Sensing Department

Spatial Data Infrastructure (SDI)
-framework-



SDI in Europe: INSPIRE Initiative

INSPIRE (Infrastructure for Spatial Information in Europe) was put forward by the **E**uropean **C**ommission in 2004 to promote and develop an European SDI. The objective is to improve the planning and implementation of Community policies in areas such as the **environment**, **transport**, **energy** and **agriculture**. This should lead to better understanding of problems such as floods or air and water pollution, which recognise no national borders.

Parliament and the Council struck a deal (approved on November 21st, 2006) which will enable data to be shared across the EU, without undermining high quality services in the Member States.

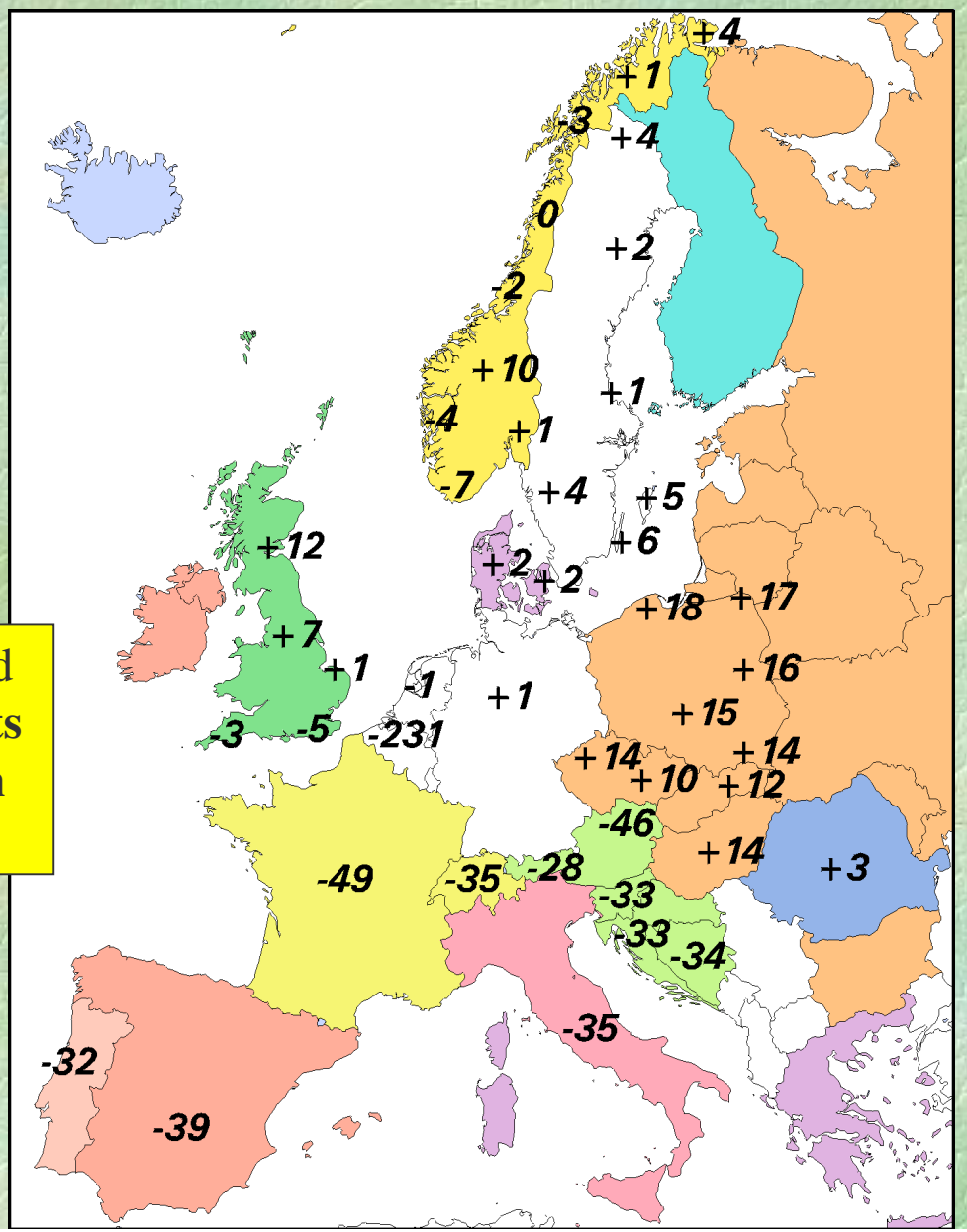
INSPIRE objectives

Make relevant, harmonised spatial data available for Community Environmental Policy (formulation, implementation, monitoring and evaluation) and for the citizen ...

… through the establishment of integrated spatial information services, based upon a distributed network of databases, linked by common standards and protocols to ensure compatibility.

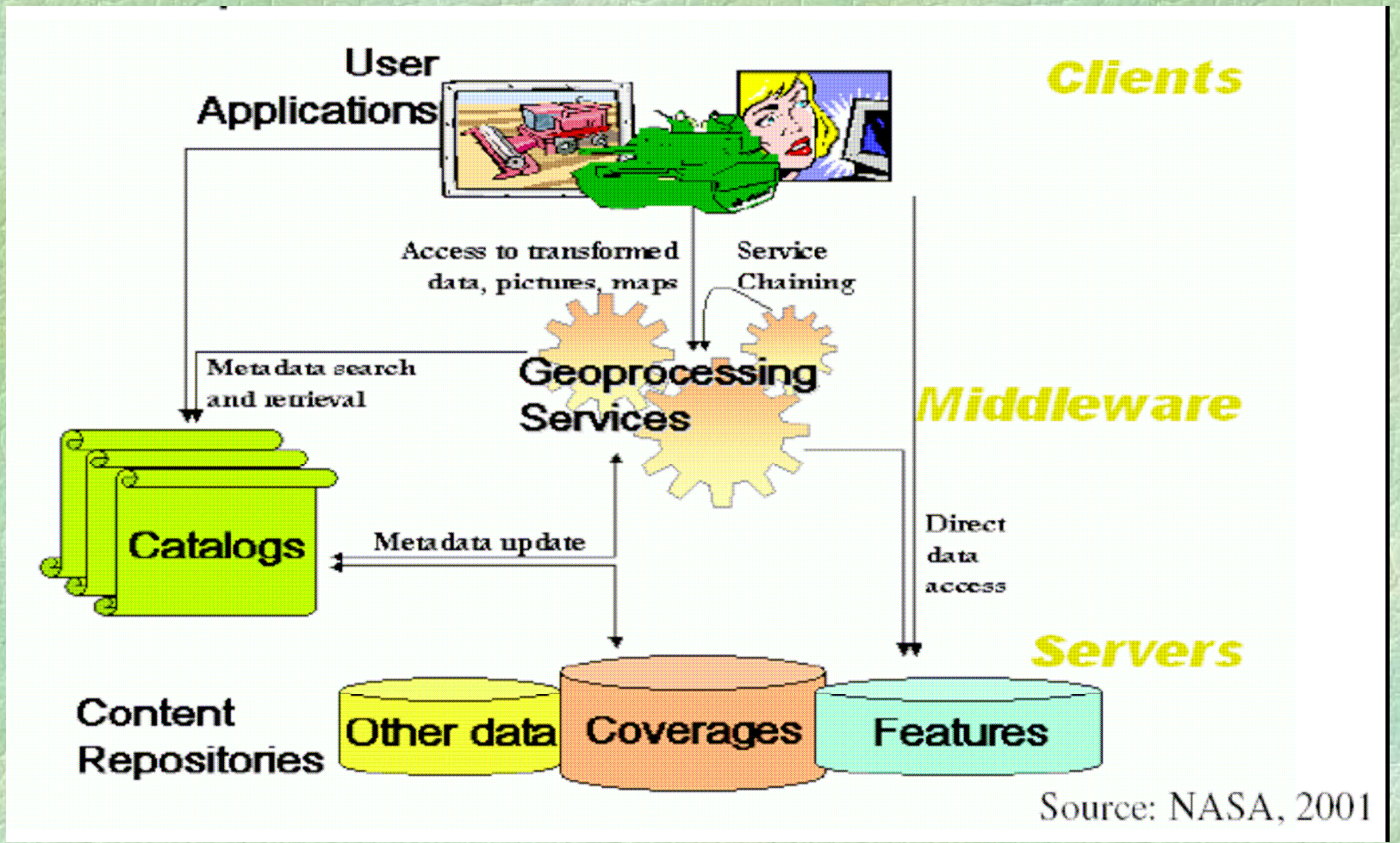
Differences in national heights

GI standardisation: Need of a European Vertical Reference System



Differences between UELN (United European Levelling Network) **heights and national heights in Europe (in cm)**

INSPIRE architecture



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- •Available studies?
- •Pedology?
- •Hydro network?
- •Local areas main troubles?
- •Pollution?
- •Landslide risk?
- •Social composition?
- •Available long-term data series?
- •Some previous report on the same topic?
- •Contacts?

Example:

Place: Morbegno (SO)

Lat: 46.10 - 46.15 N

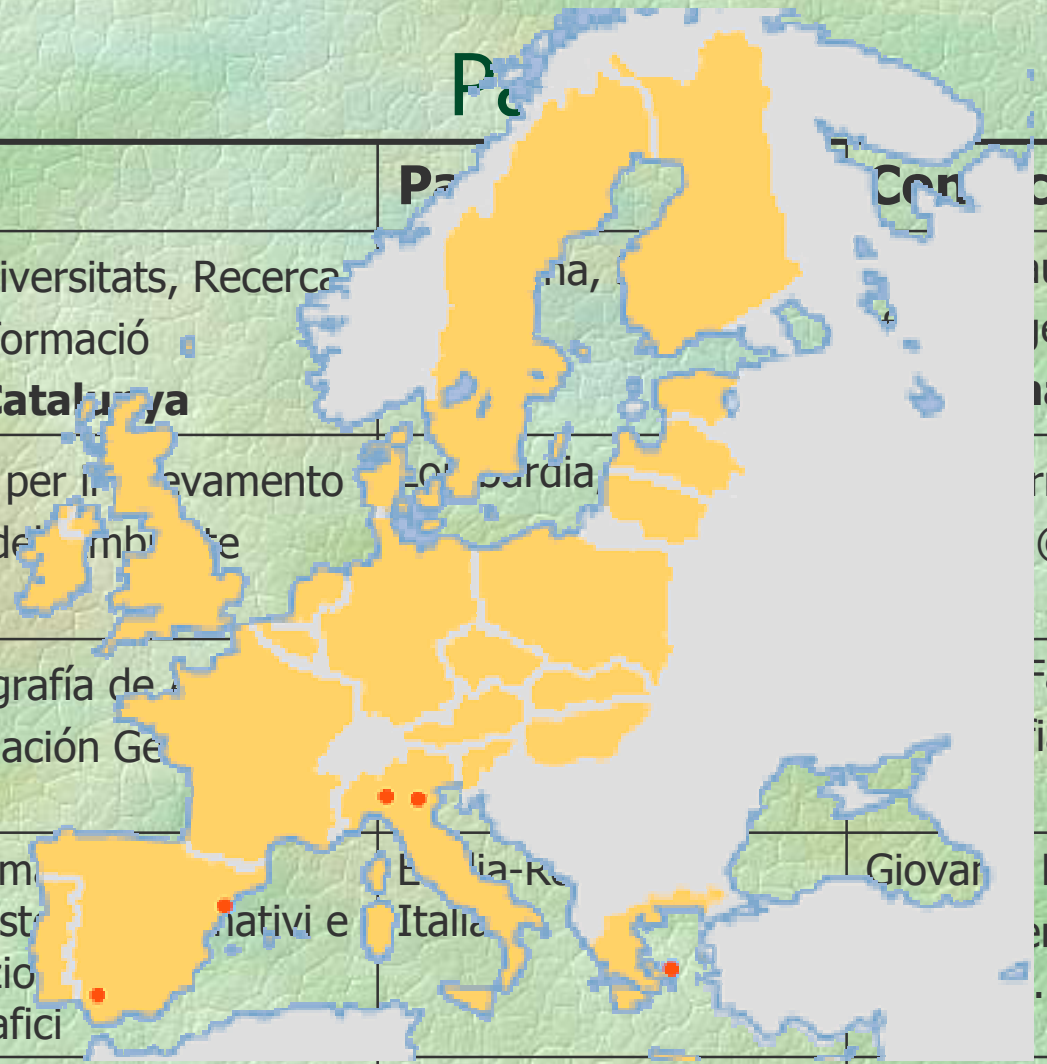
Long: 9.55 – 9.63 E

SDI

- •Report on landslides in the area of Tartano (by Unimib-Sc.Amb. Dept.)
- •Map of flood risk assessment in the area of Ardenno (by Polimi).
- •Graduation thesis on the pasturesof Albaredo (by Unimi-Agraria Dept.)
- •Values of runoff forecast of Adda river (by CNR-IREA)
- •Digital geologic map Lombardia (distributed by Unimib-Sc.Amb. and Agraria Depts.)
- •…other data…

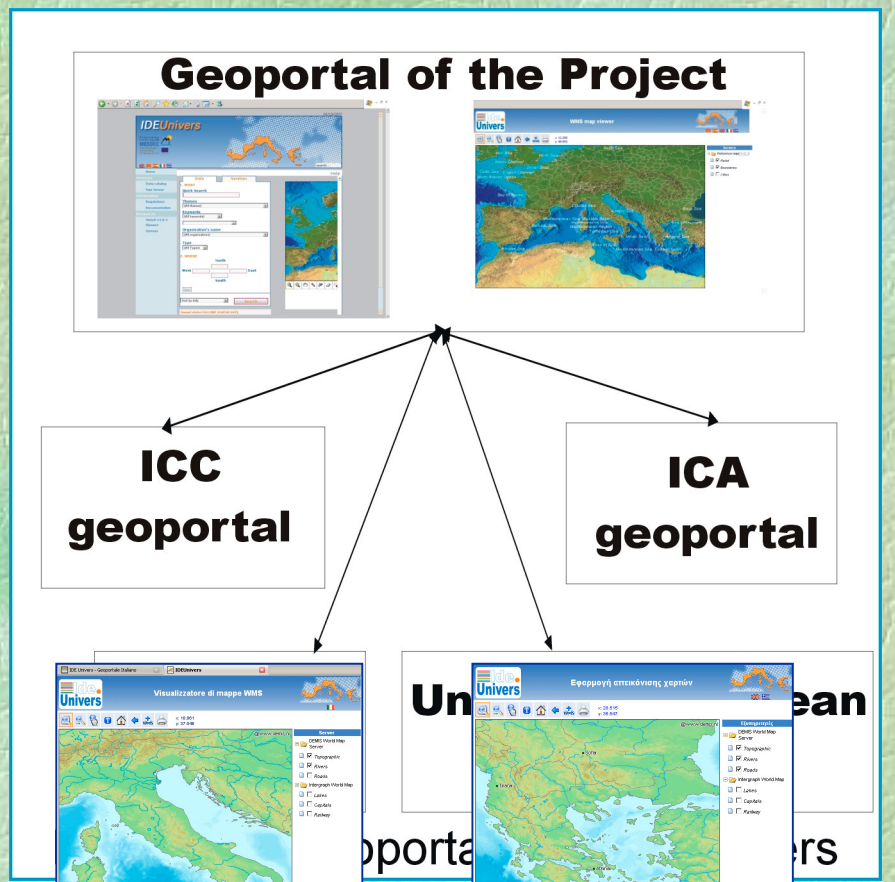
Ide.Univers

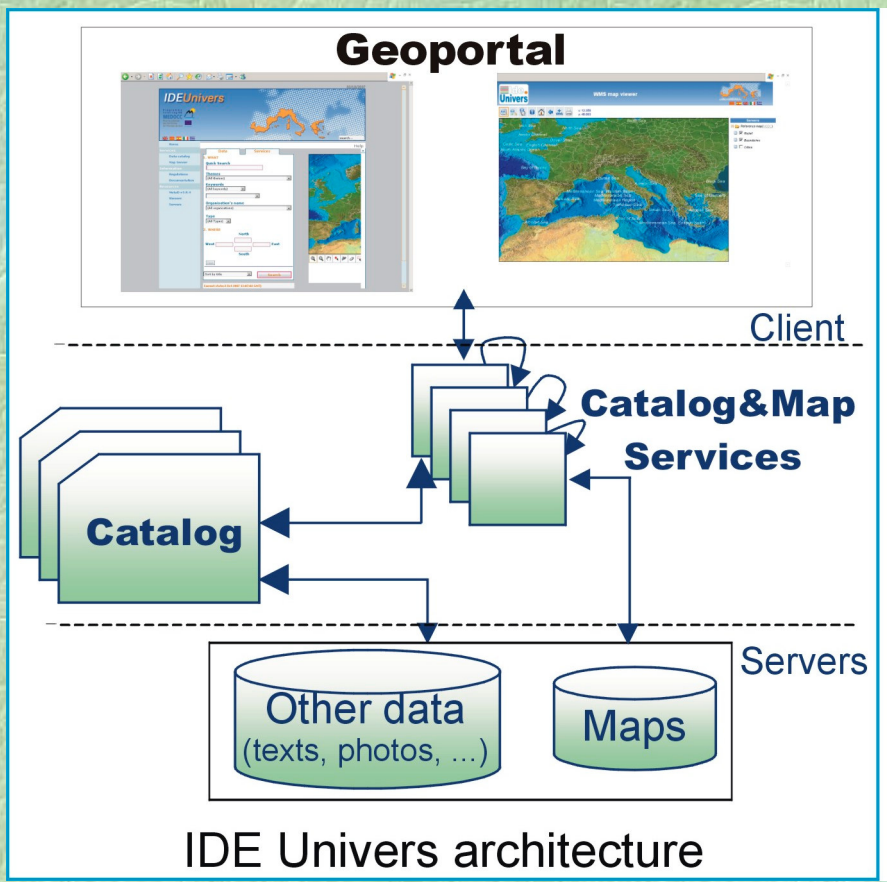
Pa



Organisation	Pa	Con ct
Departament d'Universitats, Recerca i Societat de la Informació **Generalitat de Catalunya**	na,	ura gencat.net **natore**)
CNR-IREA Istituto per i evamento Elettromagnetico de mb te	Lo bardia	rrara @irea.cnr.it
Instituto de Cartografía de Servicio de Información Ge		Fajardo ia@juntadeandalucia.es
Regione Emilia-Rom Organizzazione, Sist ativi e telematica - Servizio Informativi Geografici	E lia-R Italia	Giovar Belvederi eri@regione.emilia- .it
Università dell'Egeo-Dipartimento di Geografia	Grecia	Michail Vaitis vaitis@aegean.gr

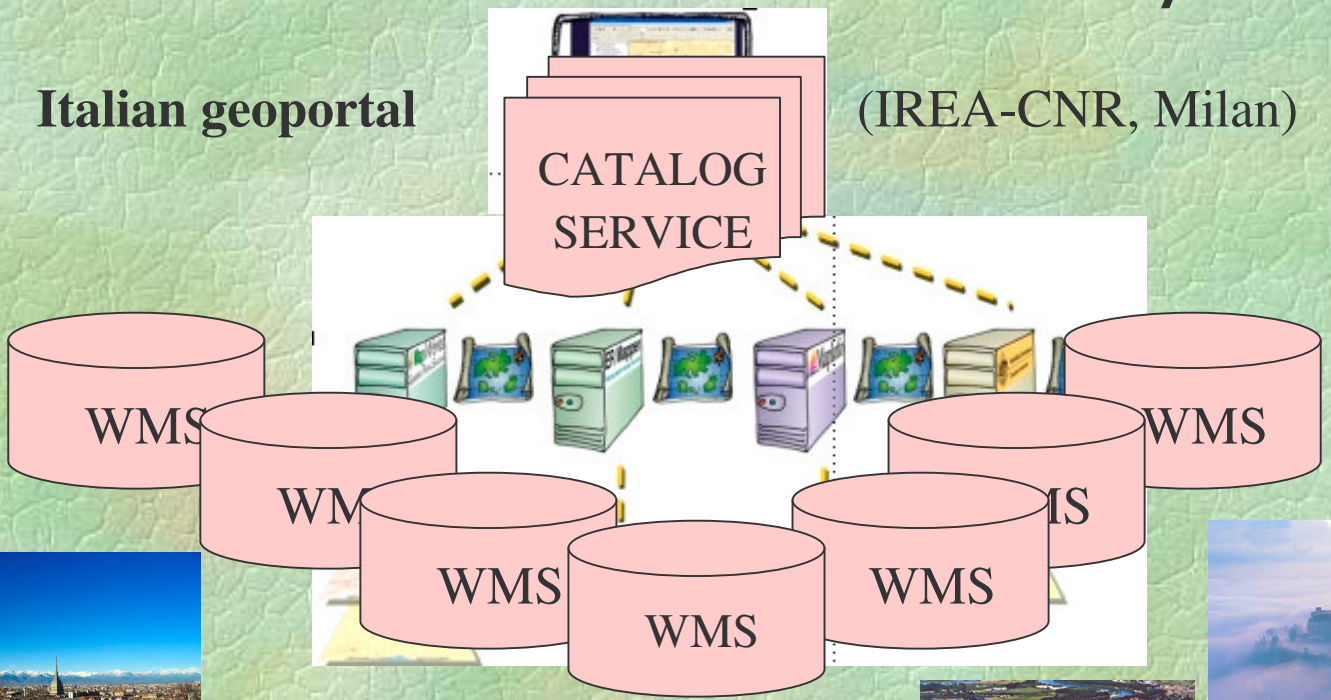
Geoportals of IDE Univers

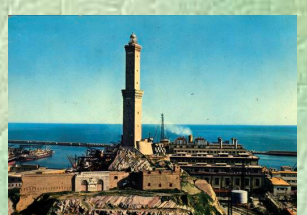


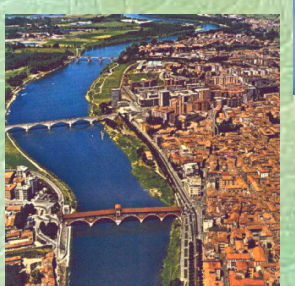


IDE Univers in Italy

Italian geoportal (IREA-CNR, Milan)







Ide.Univers

IDE Univers - Geoportale Italiano | http://155.253..../metadata.show

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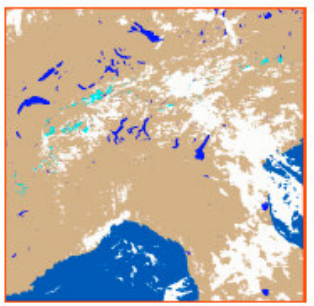
Home | Last results | Links | Help

English | Français | Esp

Username Password Lo

Default view
Advanced view
XML view

AWARE_SCA3_2003-06-23_32N_TIFF



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Title	AWARE_SCA3_2003-06-23_32N_TIFF
Date	2007-05-11
Date type	revision
Edition date	2007-05-11
Individual name	Francesca Sapio
Organisation name	RSDE Srl
Position name	Project Manager
Voice	+39-02 48007912
City	Milano
Postal code	20146
Country	Italy
Electronic mail address	fsapio@rsde.com
Role	originator
Presentation form	imageDigital
Abstract	AWARE project Snow Cover Area products rel. 3 as obtained by satellite data (sensor MODIS, Products: MOD02 and MOD35) over the Alps in GEOTIFF format
Purpose	Quantify snow extent over the Alps for hydrological applications, particularly runoff forecast

glish | Français | Español

ssword Login

at IREA-CNR address: http://geoportal:8080/geoportal/local_it.jsp

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Portale Regione Lombardia | http://155.25...en/main.home | Portale Regione Lombardia | .:: Portale Cartografico Nazi... | .:: Portale Cartografico ...

Portale Cartografico Nazionale

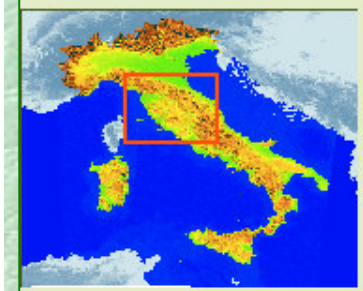
PCN SCC — Sistema Cartografico Cooperante

Zoom In

Strumenti

Navigazione Mappa

Lon: 13°23'25.72"
Lat: 44°6'40.82"
X: 371.199,07
Y: 4.885.498,65
Scala 1: 2.799.312
Seleziona una scala



Legenda

- aanp
- Limiti Amministrativi
  - Comuni Fuso 33
  - Comuni Fuso 32
  - Province Fuso 33
  - Province Fuso 32
  - Regioni Fuso 33
  - Regioni Fuso 32

Servizi Locali

Attivo
- aanp
- Limiti Amministrativi

Servizi WMS

Attivo
- WMS-AWARE-IREA

Using SDI: example
Searching data in catalogues

Using SDI: searching data in catalogues

Using SDI: results

Carta dei suoli dell'hinterland di Cagliari e della loro perdita dovuta all'espansione urbanistica dal 1954 al 1978 (Sardegna)

Abstract FAO-Unesco Soil Classification

Keywords Soils, Constraints, Soil Types, Italy

Metadata

Soil map of Sicily; Carta dei suoli della Sicilia

Abstract FAO-UNESCO; Soil Taxonony; CPCS French classifications

Keywords Soils, Soil Classification, Soil Types, Italy

Metadata

Carta dei suoli dell'Emilia-Romagna; Soil map of Emilia Romagna

Abstract (7th Approximation)

Keywords Soils, Soil Classification, Soil Types, Italy

Metadata

Soil map of Southern Lazio and adjacent Campania; Carta dei suoli del Lazio meridionale e della Campania nord-occidentale

Abstract Soil map of Southern Lazio and adjacent Campania

Keywords Soils, Soil Classification, Soil Types, Italy

Metadata

Carta dei suoli d'Italia

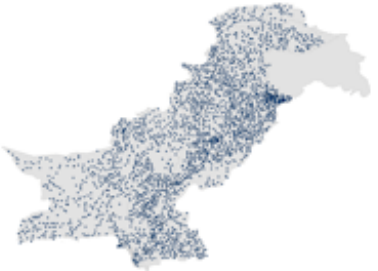
Abstract Carta dei suoli d'Italia

Keywords Soils, Soil Classification, Soil Types, Italy

Using SDI: results

PAKISTAN - HEALTH FACILITIES

Rate It



Abstract Healthcare facilities for Pakistan provided by WHO (www.who.int).

Keywords Health, Healthcare, Hospital, Pakistan

⊟ Metadata

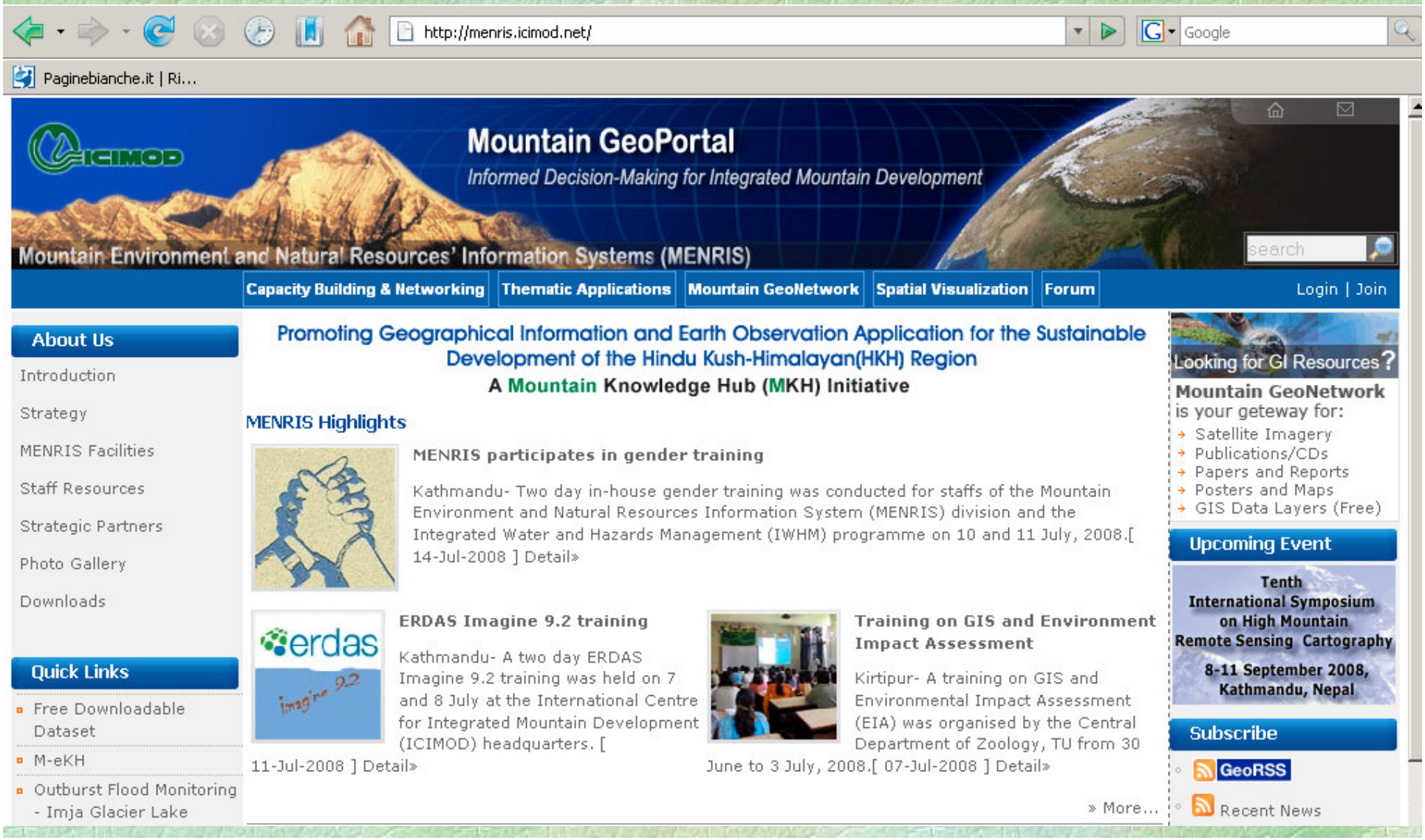
Identification info

Title	Pakistan - Health facilities
Date	
Date Type	Publication
Edition	
Presentation Form	mapDigital
Abstract	Healthcare facilities for Pakistan provided by WHO (www.who.int).
Purpose	To provide an overview of the health care that WHO is involved with.
Status	onGoing

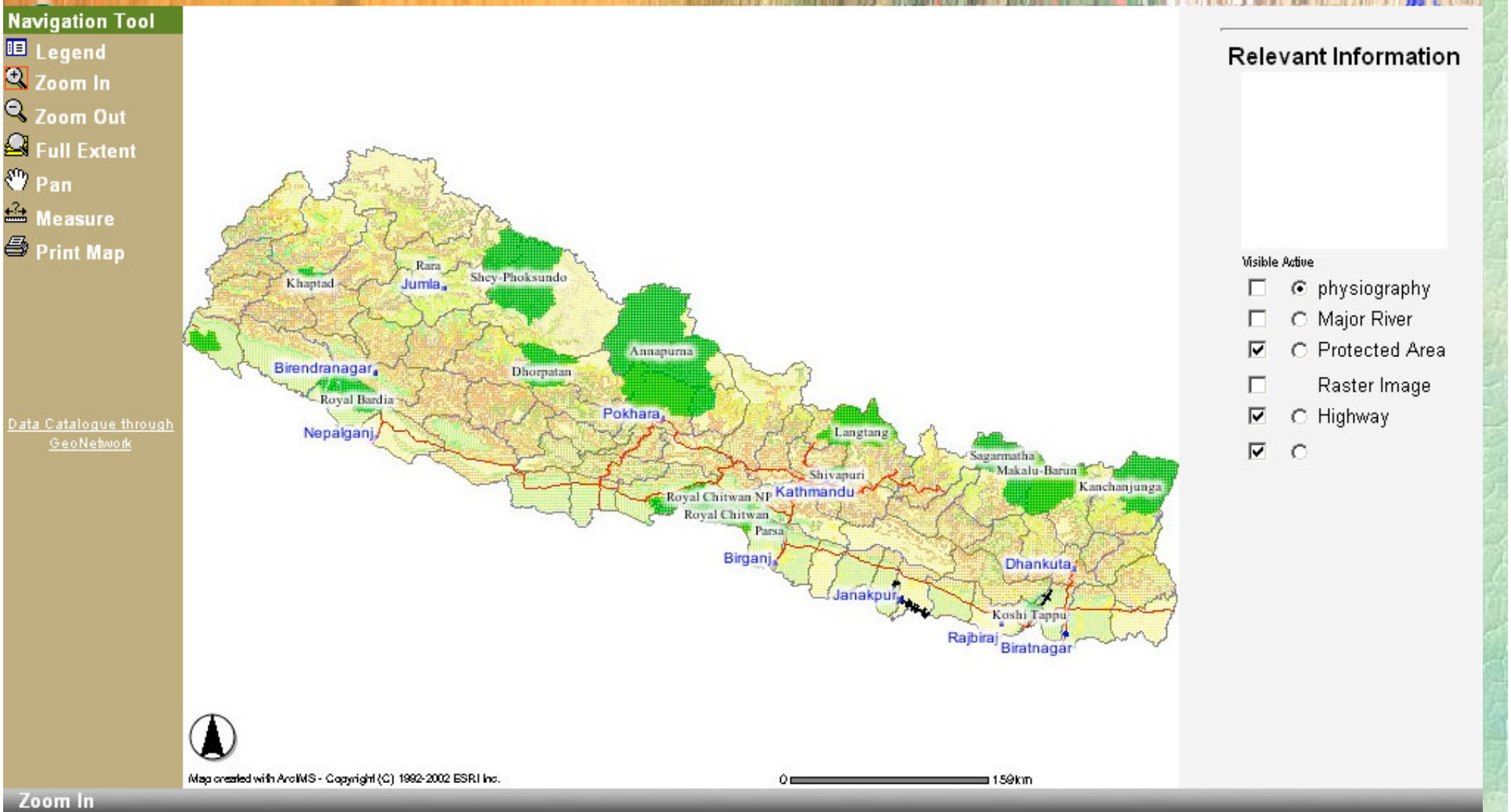
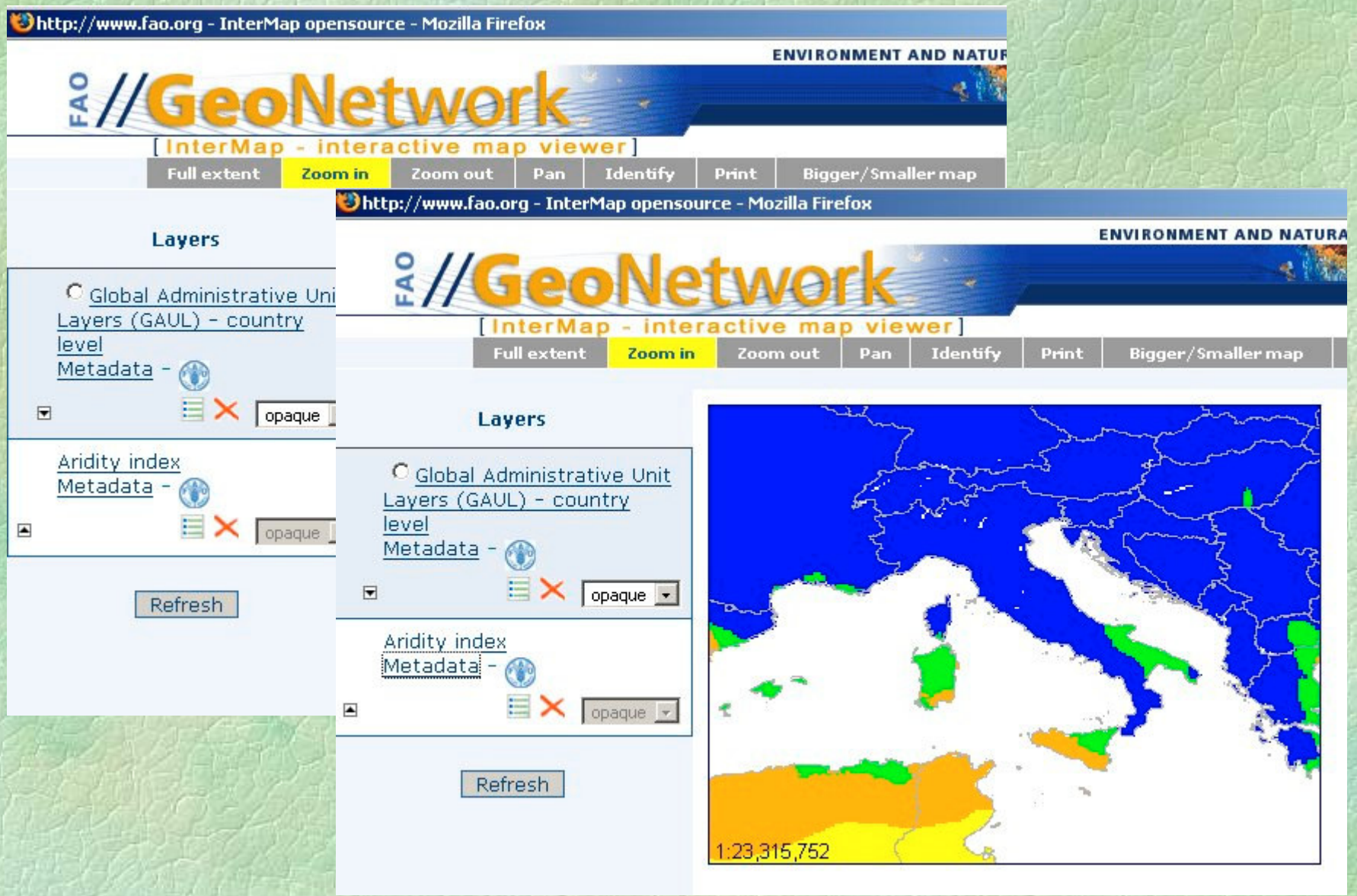
Point of contact

Individual Name	Paolo Palmero
Organisation Name	UNOCHA
Position Name	Associate Expert in Information Management
Voice	+1 917 367 5424
Facsimile	
Delivery Point	
City	New York
Administrative Area	New York
Postal Code	10017

Using SDI: map service



Using SDI: map service



Using SDI: map service