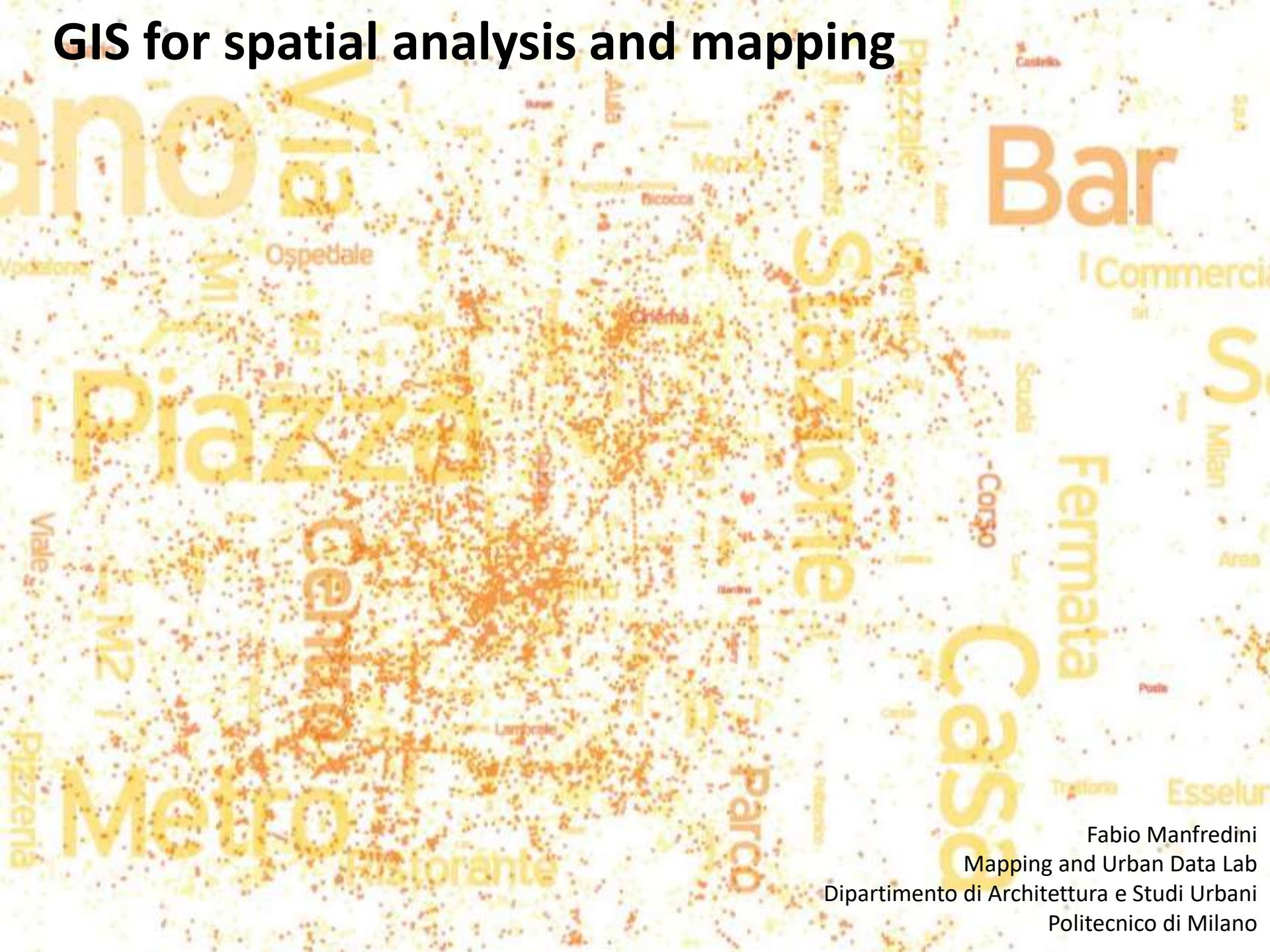


GIS for spatial analysis and mapping



Fabio Manfredini

Mapping and Urban Data Lab

Dipartimento di Architettura e Studi Urbani

Politecnico di Milano

GIS and the geospatial revolution

This Geospatial Revolution has resulted in the development of consumer GPS tools, interactive web maps, and location-aware mobile devices. These radical advances are making it possible to use, collect, and understand spatial information like never before.

- **Global Positioning Systems, GPS**

a device that is capable of receiving information from GPS satellites and then to accurately calculate its geographical location. The Global Positioning System (GPS) is a global navigation satellite system (GNSS)

- **Remote Sensing, RS**

Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites.

- **Geographic Information Systems, GIS**

- **Crowdsourced information**

GIS

A geographic information system or GIS integrates data, hardware, software to assist in the analysis and display of geographically referenced information.

The key word to this technology is Geography –some portion of the data is spatial. In other words, data that is in some way **referenced to locations** on the earth. Coupled with this data is usually tabular data known as attribute data.

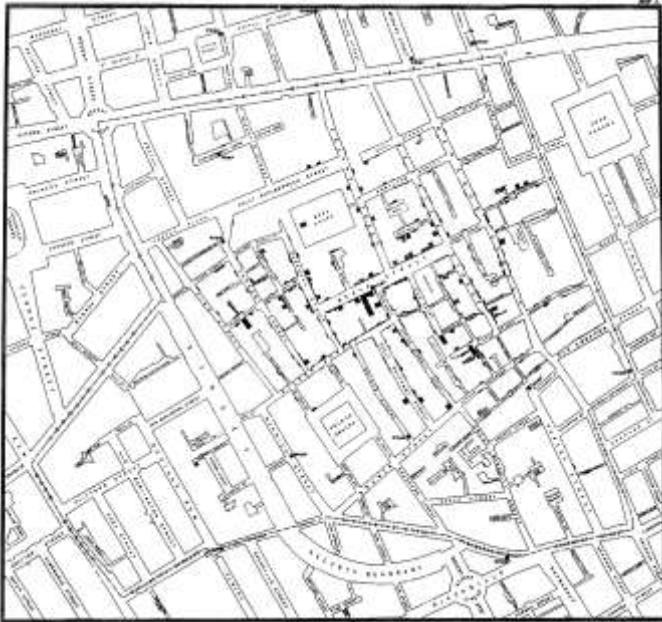
GIS collect , organize, elaborate and visualize spatial information

GIS are not maps

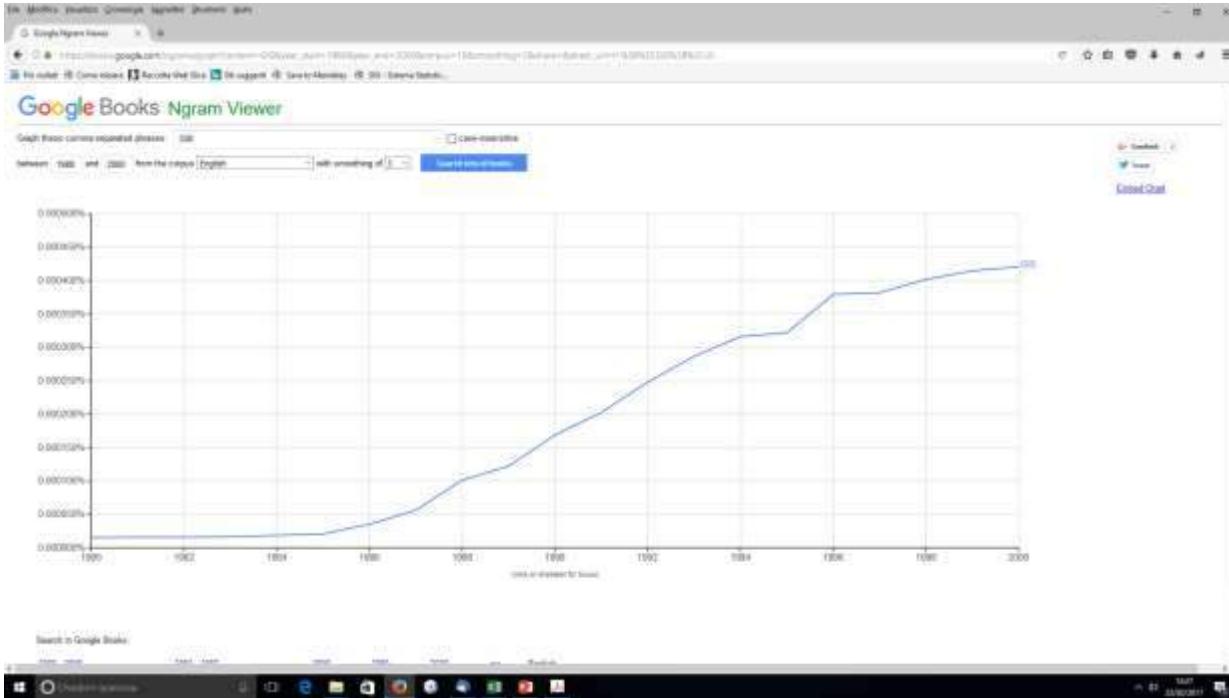
Complex spatial operation

Huge dataset

Multi source data



Original map by John Snow showing the clusters of cholera cases in the London epidemic of 1854. The pump is located at the intersection of Broad Street and Cambridge Street.



Created in the 60s, in the early 90s, the use of GIS had already become popular.

GIS are only a component of geospatial technologies (geoweb)



Google Earth, Bing, Here,

web mapping – Mapbox, Carto, umap, ...



Geodesign and data visualization

3d Model and simulation



Open data

Spatial Open data

Satellite images: Sentinel, Landsat,

VGI (Volunteered Geographic Information) - Openstreetmap



Yesterday

Only Proprietary Software

Not free data, available on physical support (CD-ROM)

Expensive hardware

Not easy to share

Stand alone use

Now

Proprietary Software and Open source software

Spatial Open data available

ICT and WEB 2.0, GEOWEB

Social networking sites (e.g. Foursquare, Twitter)

New geospatial technologies

Mobile technologies that couple location-based connectivity with cameras and other sensing systems.

GIS programming language

Easy to share

Open source / Open source GIS

The program must include source code, and must allow distribution in source code as well as compiled form.

The **license** must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

Community of users and developers.

[Quantum GIS](#): multiplatform, frequent releases, strong community of users

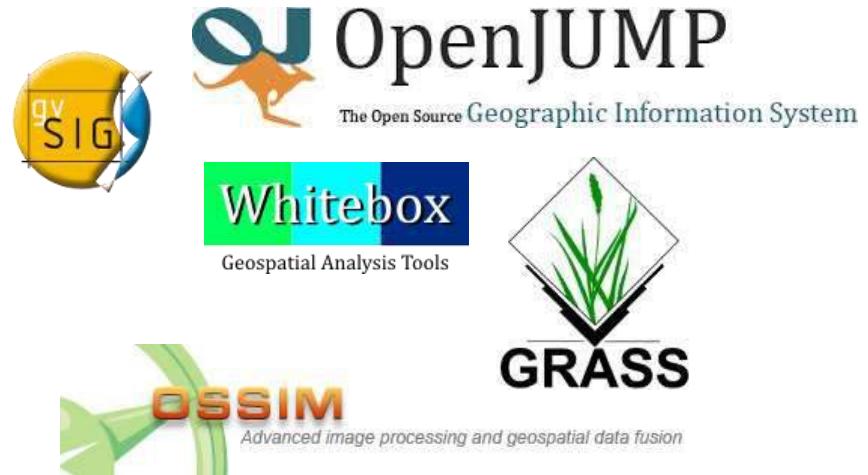
[uDig](#): editing, visualizzazioni e analisi

[OpenJump](#): editing e vector

[WhiteBox](#): remote sensing

[GRASS](#): model and analysis e analisi

[SAGA](#): model and analysis e analisi



Proprietary GIS

Arcgis Desktop / Arcgis Online – Esri: full system for managing spatial data

Geomedia – Intergraph: spatial analysis, spatial data infrastructure

AutoCAD map – Autodesk: CAD + GIS

Mapinfo – Mapinfo: vector + raster

Erdas – Erdas: satellite images

Arcgis

The screenshot shows the official ArcGIS website. At the top, there's a header bar with the title "ArcGIS for Desktop" and a search bar containing "esri arcgis". Below the header, the Esri logo is prominently displayed next to a navigation menu with links for "Industries", "Products", "Support & Services", "About", and "Community". On the far right of the header, there's a "Sign In" link and a search icon. The main content area is organized into four columns: "Products" (listing ArcGIS Online, ArcGIS for Desktop, ArcGIS for Server, and a "See all products" link), "Apps" (listing Collector for ArcGIS, Explorer for ArcGIS, GeoPlanner for ArcGIS, Open Data, Web Application Templates, and Web AppBuilder for ArcGIS, with a "See all apps" link), "Capabilities" (listing Spatial Analysis, Image Mgmt & Analysis, 3D, Open Platform, Big Data, and a "See more capabilities" link), and "Content" (listing Basemaps, Demographics, Lifestyle, Imagery, For Developers, and Free Trials).

Products	Apps	Capabilities	Content
ArcGIS Online	Collector for ArcGIS	Spatial Analysis	Basemaps
ArcGIS for Desktop	Explorer for ArcGIS	Image Mgmt & Analysis	Demographics
ArcGIS for Server	GeoPlanner for ArcGIS	3D	Lifestyle
See all products	Open Data	Open Platform	Imagery
Solutions	Web Application Templates	Big Data	For Developers
	Web AppBuilder for ArcGIS	See more capabilities	Free Trials
	See all apps		

POLIMI has a full Arcgis license

Proprietary and open source GIS



Proprietary



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



To register a new case study, the [case studies form](#) (document in .odt format; this format can be visualized using [LibreOffice](http://www.libreoffice.org))

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

Open source

Proprietary and open source GIS: a comparison

Characteristic	Open Source	Proprietary
Cost	Low or no	High
Updates	Frequent	Less frequent than OS. Each new release -> high improvement
Manuals and documentation	Present but the quality and the completeness depends on the community of users Forums available	Professional, books, website, manuals Forums available
Who realizes the software	Foundations, research centres	Private firm
Diffusion	Global	Global but concentrated in some countries
Strengths	Possibility to integrate new functions, active community of users, price, functions,	Documentation, support, translations, functions, layout,...

Time until Feature freeze: 2017-08-18 12:00:00 UTC 63d 23h 57m

QGIS

A Free and Open Source Geographic Information System



Create, edit, visualise, analyse and publish geospatial information on Windows, Mac, Linux, BSD (Android coming soon)

For your desktop, server, in your web browser and as developer libraries

[Download Now](#)

Support QGI

Version 2.18.11 (new LTR)
Version 2.18.17 (previous LTR)

Орните път



Bloccato

File Modifica Visualizza Cronologia Segnalini Documenti Aiuto

Download QGIS

www.qgis.org/en/site/forusers/download.html

2.18.11 (new LTR)
2.14.17 (previous LTR)

DISCOVER QGIS FOR USERS GET INVOLVED DOCUMENTATION English

Binary packages (installers) for current stable version 2.18 can be downloaded here.

INSTALLATION DOWNLOADS ALL RELEASES SOURCES

Download for Windows

Latest release (eg. for New Users):

-  QGIS Standalone Installer Version 2.18 (32 bit)
md5
-  QGIS Standalone Installer Version 2.18 (64 bit)
md5

Long term release repository (eg. for corporate users):

-  QGIS Standalone Installer Version 2.14 (32 bit)
md5
-  QGIS Standalone Installer Version 2.14 (64 bit)
md5

For Advanced Users:

-  OSGeo4W Network Installer (32 bit)
md5
-  OSGeo4W Network Installer (64 bit)
md5

Scrivi qui per eseguire la ricerca

1301 24/07/2017

Version 2.18.24 LTR «Las Palmas»

Download and Install QGIS

Software download page:

<http://www.qgis.org/en/site/forusers/download.html>

Download for Windows

- Qgis Standalone Installer Version 2.18 (32 bit or a 64 bit a seconda del sistema operativo);

Download for Mac OS X - Mac Installer Package for both OS X Mavericks (10.9), Mountain Lion (10.8) and Lion (10.7):

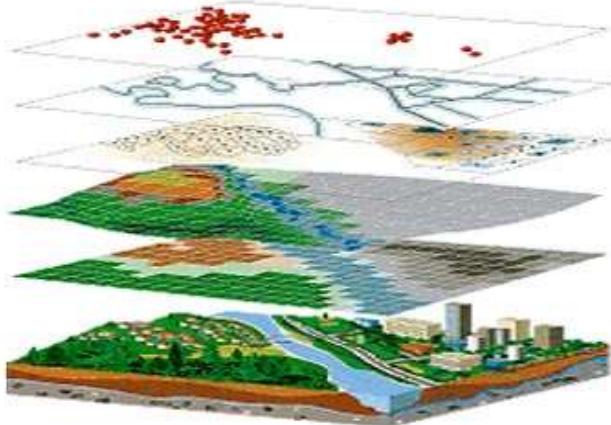
- This version requires **separate installation of dependency framework (GDAL Complete)** <http://www.kyngchaos.com/software/frameworks>
- Download Qgis: <http://www.kyngchaos.com/software/qgis>

Download for Linux – GNU/Linux binary packages (rpm and deb) or software repositories are available.

<http://www.qgis.org/en/site/forusers/alldownloads.html#linux>

GIS data

GIS



http://www.izmo.it/Wikizmo/Articoli/Geographical_Information_Systems

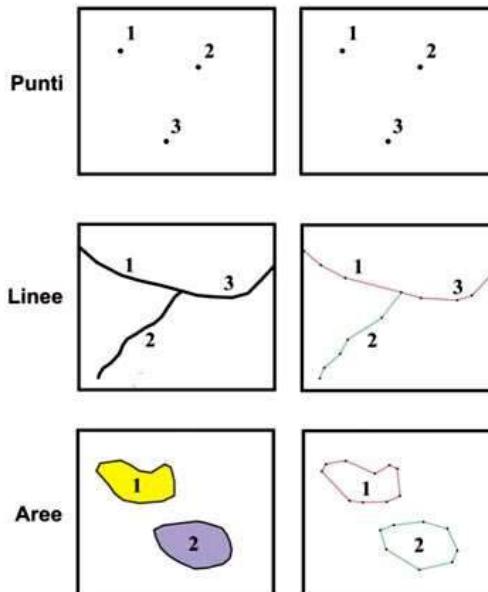
Geometry

Topology

Attributes

Spatial data are georeferenced

Vector

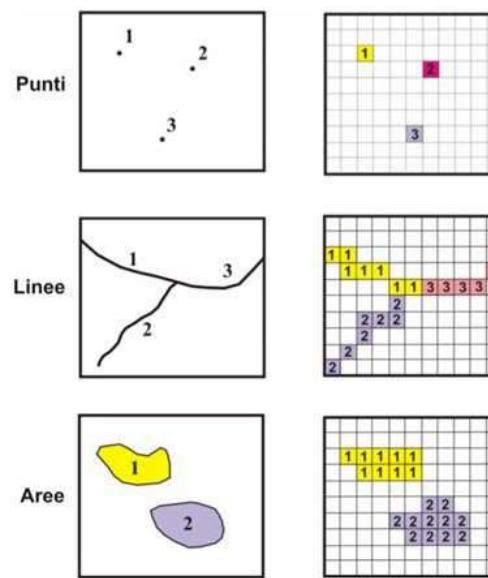


A **point** is defined by a single pair of coordinate values. A point normally represents a geographic feature that is too small to be represented as a line or area.

A **line** is defined by an ordered list of coordinate pairs defining the points through which the line is drawn.

An **area** is defined by the lines that make up its boundary. Areas are also referred to as **polygons**.

Raster



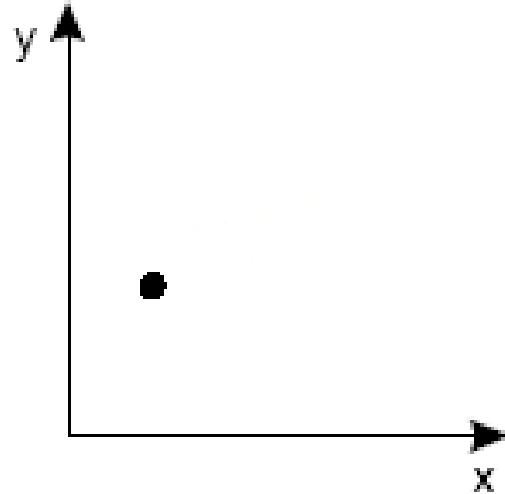
The raster data model is an abstraction of the real world where the basic unit of data (points, lines and areas) is represented using a matrix of cells or '**pixels**'.

The raster model uses the grid-cell data structure where the geographic area is divided into cells identified by rows and columns.

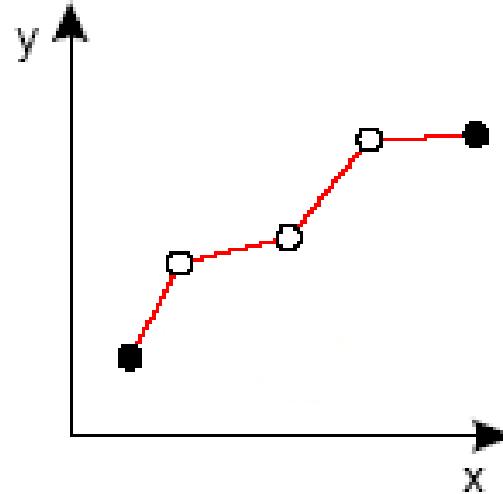
The following information must be known when using raster data:

- grid extent (number of rows and columns)
- grid resolution (size of grid cell)
- georeferencing information (e.g. corner coordinates)

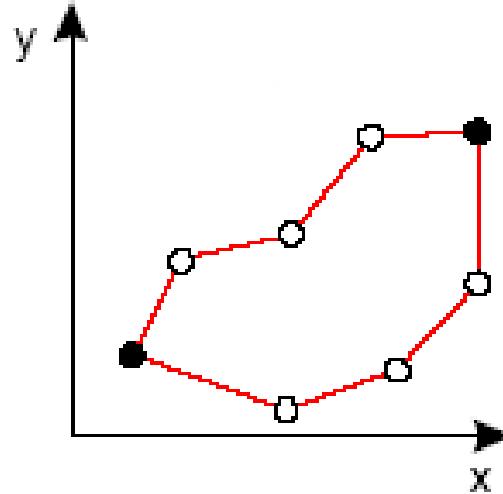
Vector data model



Point

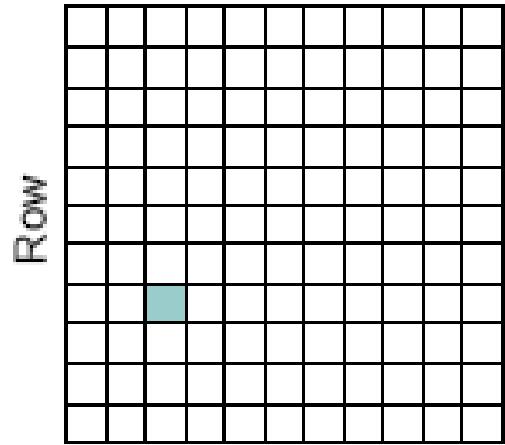


Line

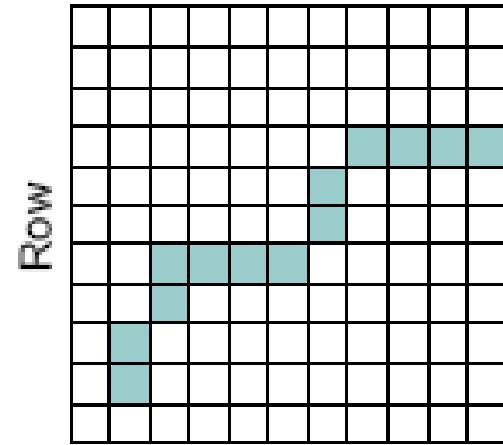


Area

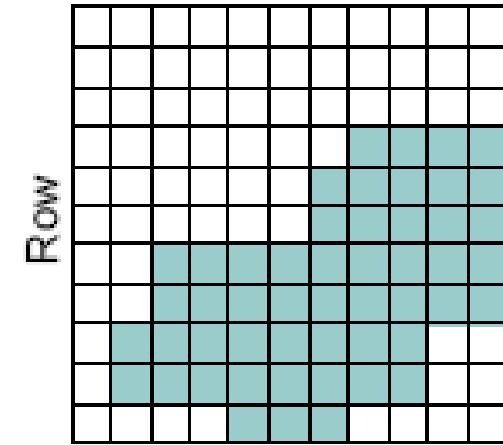
Raster data model



Column

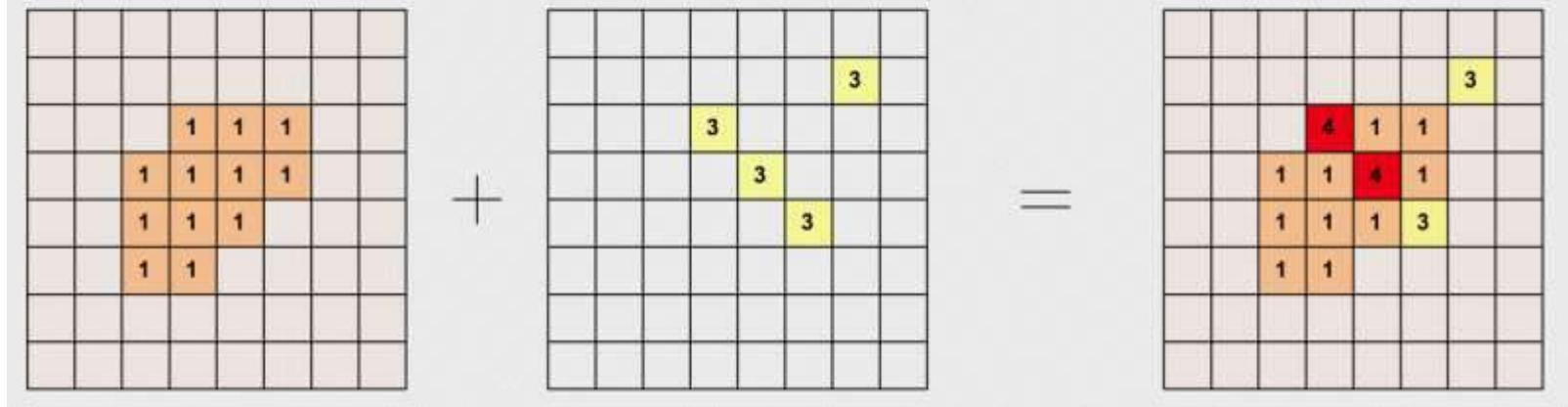


Column



Column

Vector vs Raster

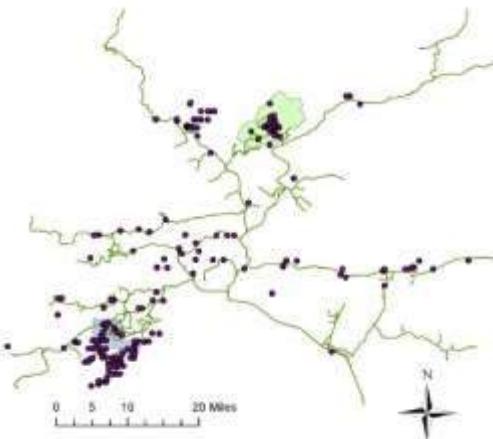


Qgis data

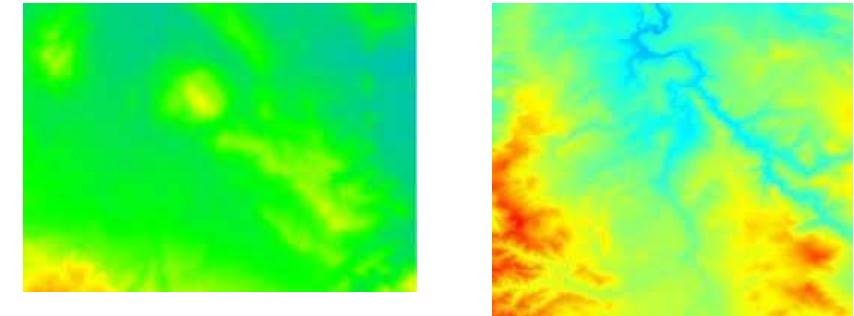
1. GDAL - Geospatial Data Abstraction Library **Vector and raster**

GDAL is a translator library for raster and vector geospatial data formats that is released under an [X/MIT](#) style [Open Source](#) license by the [Open Source Geospatial Foundation](#). As a library, it presents a [single raster abstract data model](#) and [vector abstract data model](#) to the calling application for all supported formats. Traditionnaly GDAL used to design the raster part of the library, and OGR the vector part for Simple Features. Starting with GDAL 2.0, both sides have been more tightly integrated.

Vector



Raster



Qgis data

2. Spatial database - vector

POSTGIS

Spatialite

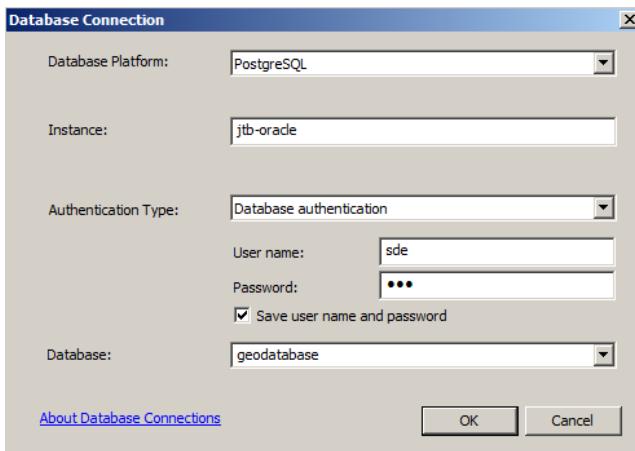
MSSQL

Oracle

Oracle Georaster

SQL Anywhere

A **spatial database** is a [database](#) that is optimized to store and query data that represents objects defined in a geometric space. Most spatial databases allow representing simple geometric objects such as points, lines and polygons. While typical databases are designed to manage various numeric and character types of data, additional functionality needs to be added for databases to process spatial data types efficiently. These are typically called *geometry* or *feature*.



GEOMETRY Column

ID	CODE	CNTRY_NAME	POP_CNTRY	CURR_TYPE	CUR...	FIPS	geom
1	AW	Aruba	67074	Florin	AWG	AA	0x0000000000104050000
2	AC	Antigua and Barbuda	65212	EC Dollar	XCD	AC	0x00000000001040A0000
3	AF	Afghanistan	17250390	Afghani	AFA	AF	0x0000000000104460000
4	DZ	Algeria	27459230	Dinar	DZD	AG	0x0000000000104480000
5	AZ	Azerbaijan	5487866	Manat	AJ	AJ	0x00000000001043C0000
6	AL	Albania	3416945	Lek	ALL	AL	0x0000000000104170000
7	AM	Amenia	3377228	Dram	AM	AM	0x0000000000104280000
8	AD	Andorra	55335	Peseta	ADP	AN	0x0000000000104050000
9	AO	Angola	11527260	Kwanza	AOK	AO	0x0000000000104330000
10	AS	American Samoa	53000	US Dollar	USD	AQ	0x0000000000104040000
11	AR	Argentina	33796870	Peso	ARA	AR	0x0000000000104CA0000

Qgis data

3. Wep map services

WMS

The Open Geospatial Consortium (OGC), Web Map Service (WMS) specification is an international specification for serving and consuming dynamic maps on the web. A WMS server usually serves the map in a [bitmap](#) format, e.g. PNG, GIF or JPEG.

WFS

The Open Geospatial Consortium (OGC), **Web Feature Service (WFS)** provides an [interface](#) allowing requests for [geographical](#) features across the [web](#) using platform-independent calls. Unlike the OGC Web Map Service (WMS), which returns an image of a map, the WFS service returns actual features with geometry and attributes that clients can use in any type of geospatial analysis.

4. Text file tables

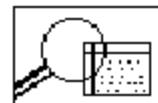
A delimited text file is a tabular data with each column separated by a defined character and each row separated by a line break. The first row usually contains the column names. A common type of delimited text file is a CSV (Comma Separated Values), with each column separated by a comma. Such data files can also contain positional information.

GIS functions

Search:



Interpolation



Thematic Search



Spatial Search



(Re-)classification

Location Analysis:



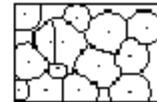
Buffer



Corridor



Overlay



Thiessen/Voronoi

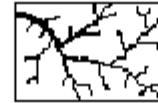
Terrain Analysis:



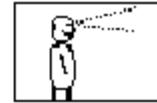
Slope/Aspect



Catchment/Basins



Drainage/Network

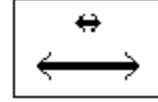


Viewshed Analysis

Distribution/
Neighborhood:



Cost/Diffusion/Spread

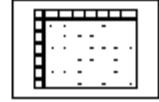


Proximity



Nearest Neighbor

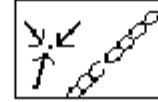
Spatial Analysis:



Multivariate Analysis



Pattern/Dispersion

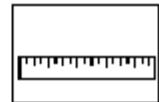


Centrality/Connectedness



Shape

Measurements:



Measurements

Address geocoding, Network Analysis,

GIS outputs

General-purpose maps

Topographic Map

Thematic maps

Dot Density Map

Isoline (Isarithmic) Map

Graduated Symbol Map

Choropleth Map (Graduated Color)

Density Map

.....

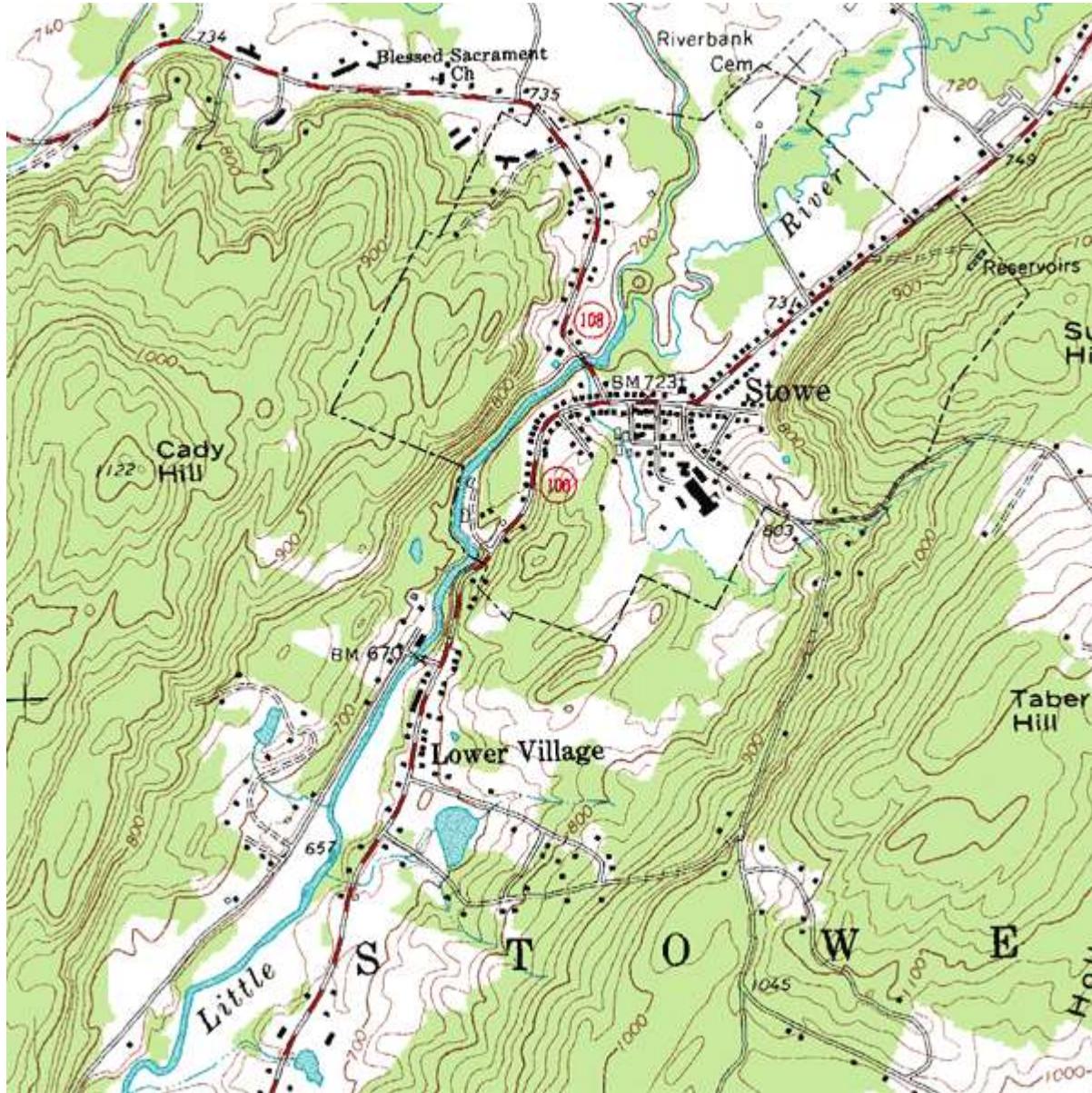
Statistics

Graph

Reports

Webmap

GIS outputs: examples

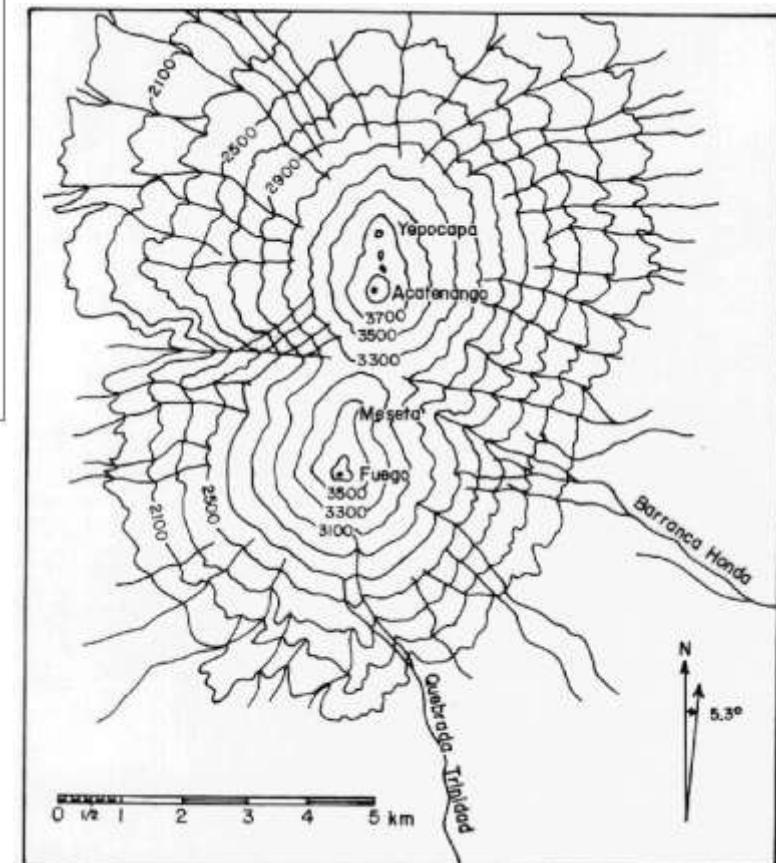
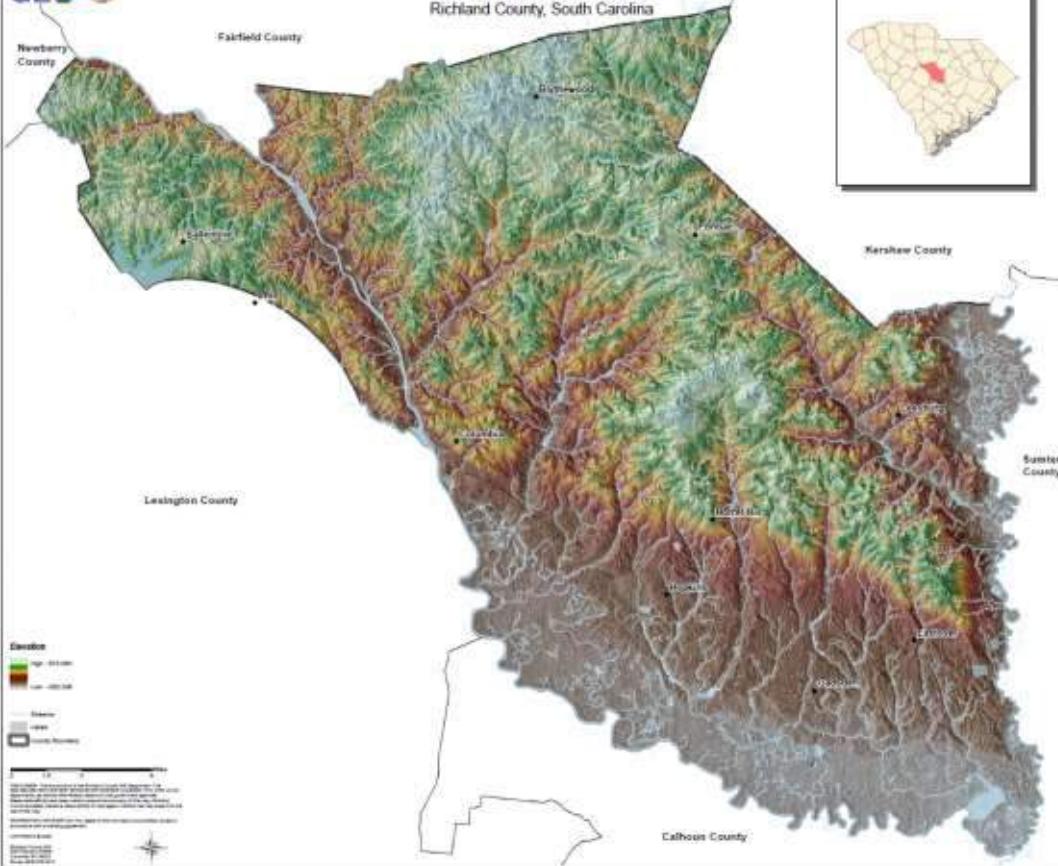


Topographic map

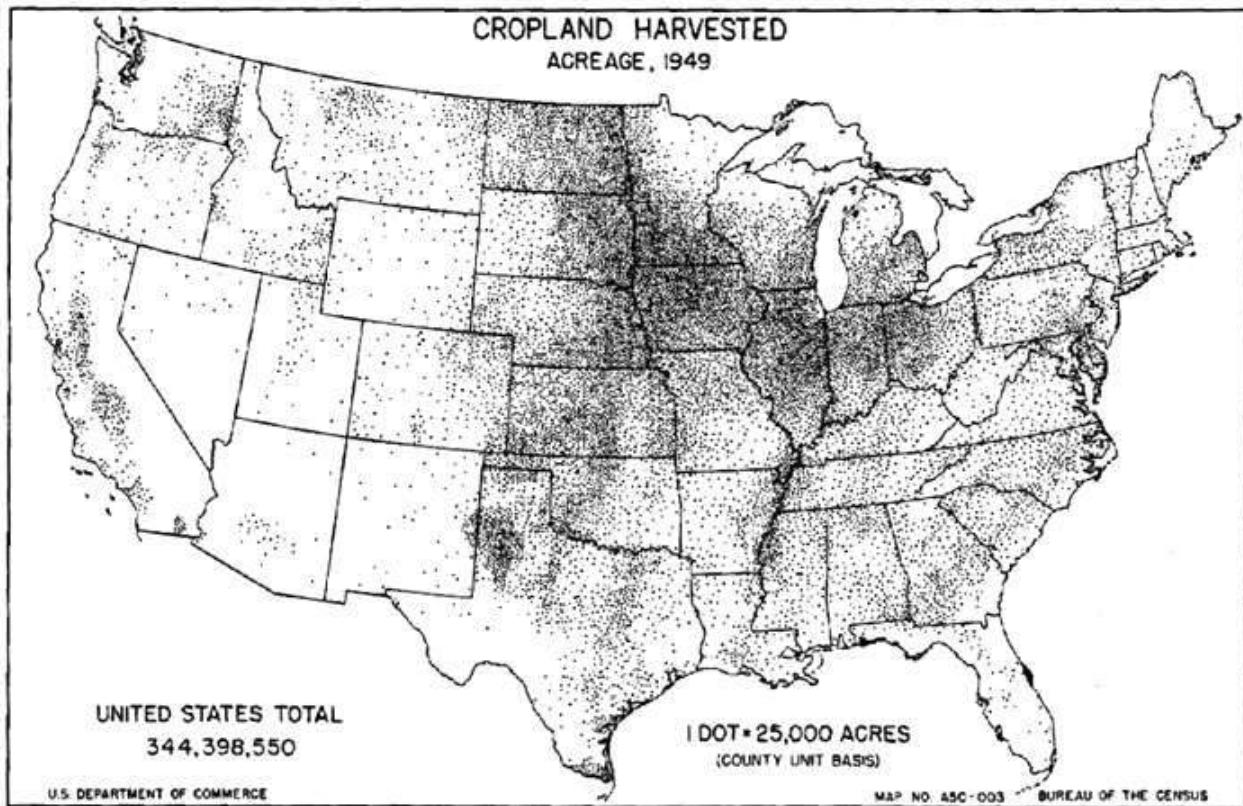


Topography (Elevation)

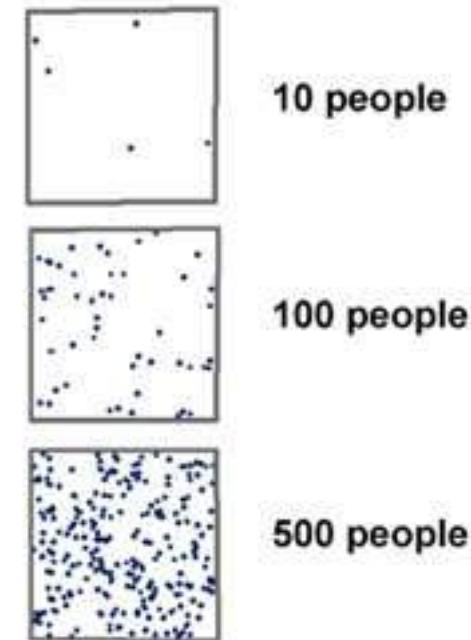
Richland County, South Carolina



Elevation map: raster / vector

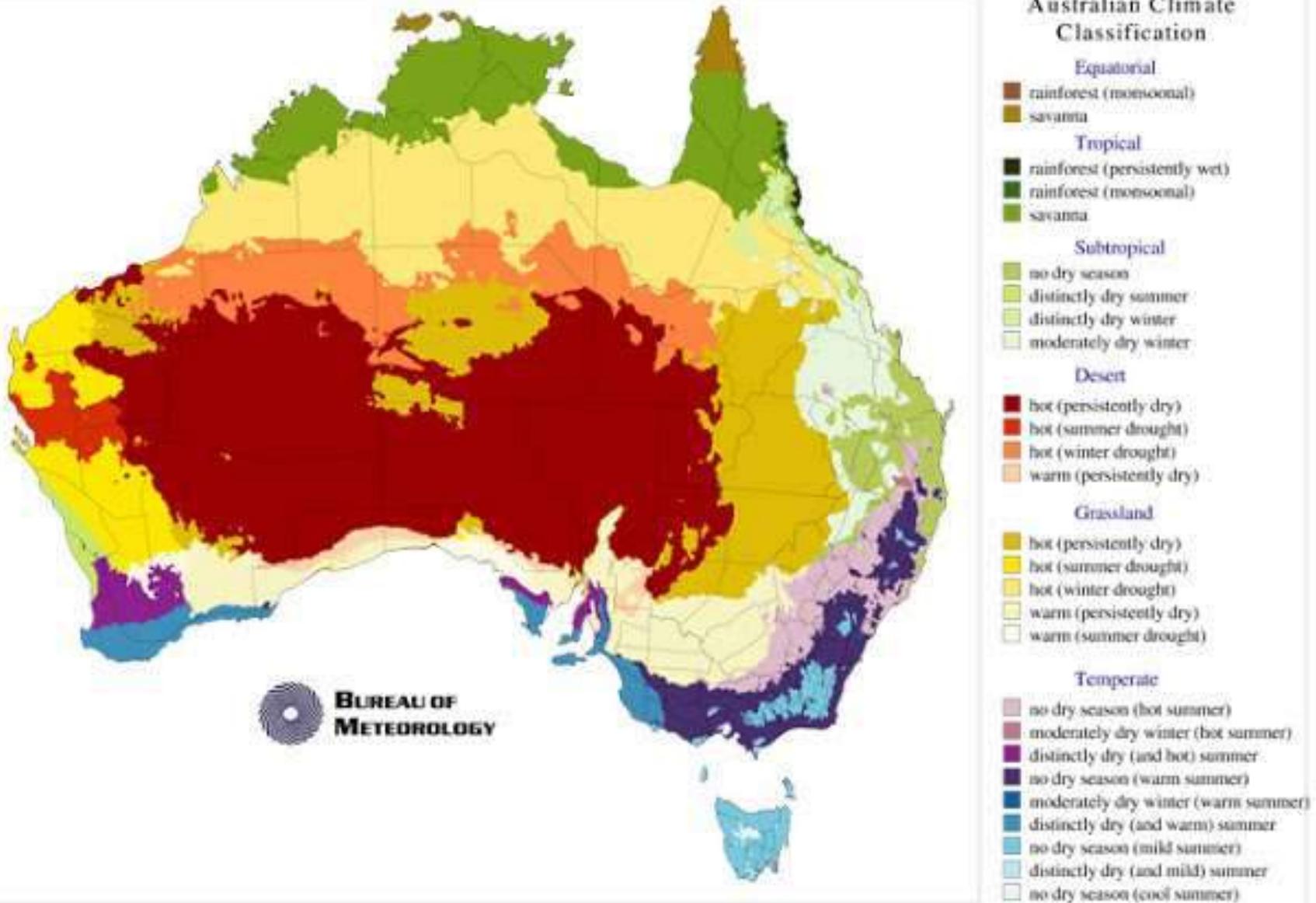


Source: US Department of Commerce



1 dot represents two people.

Dot density map



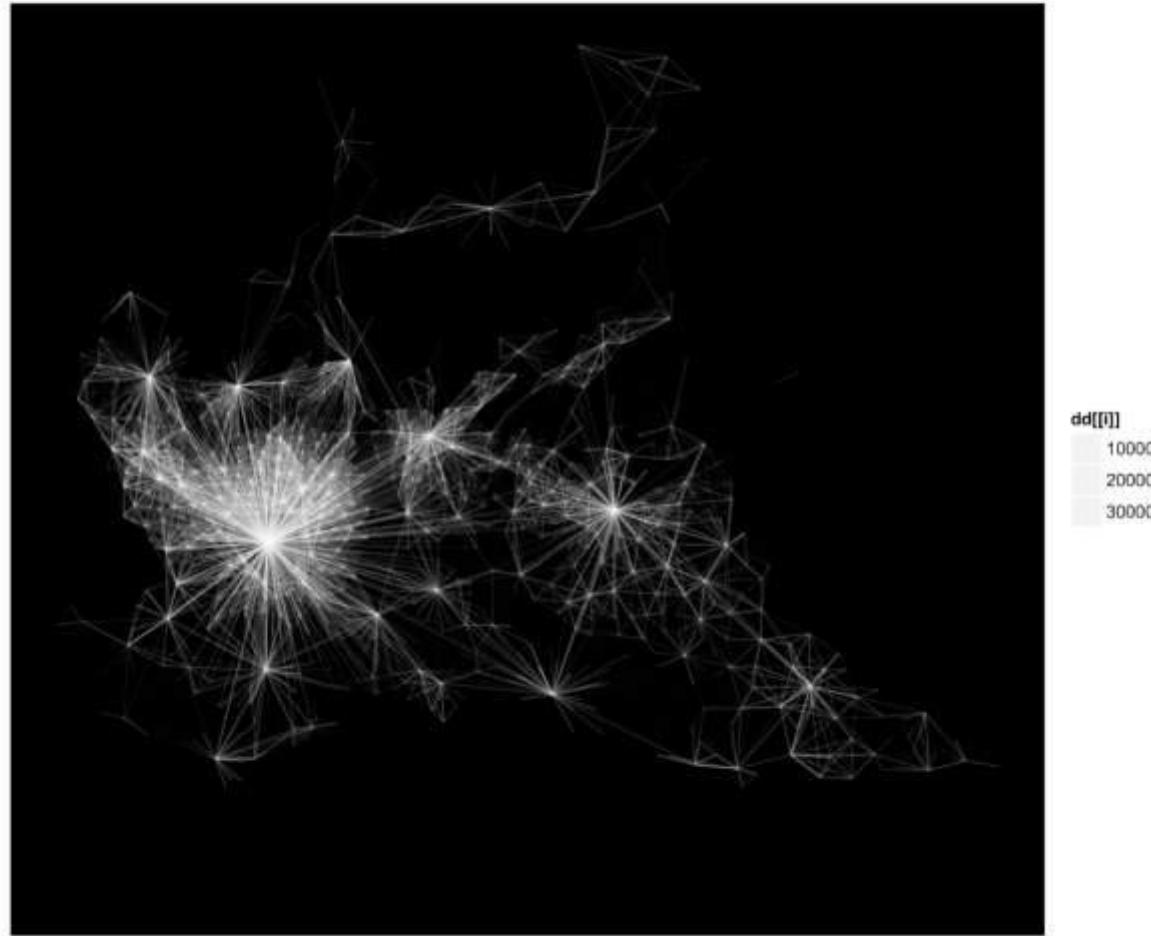
BUREAU OF
METEOROLOGY

Source: Brisbane Bureau of Meteorology

Thematic map

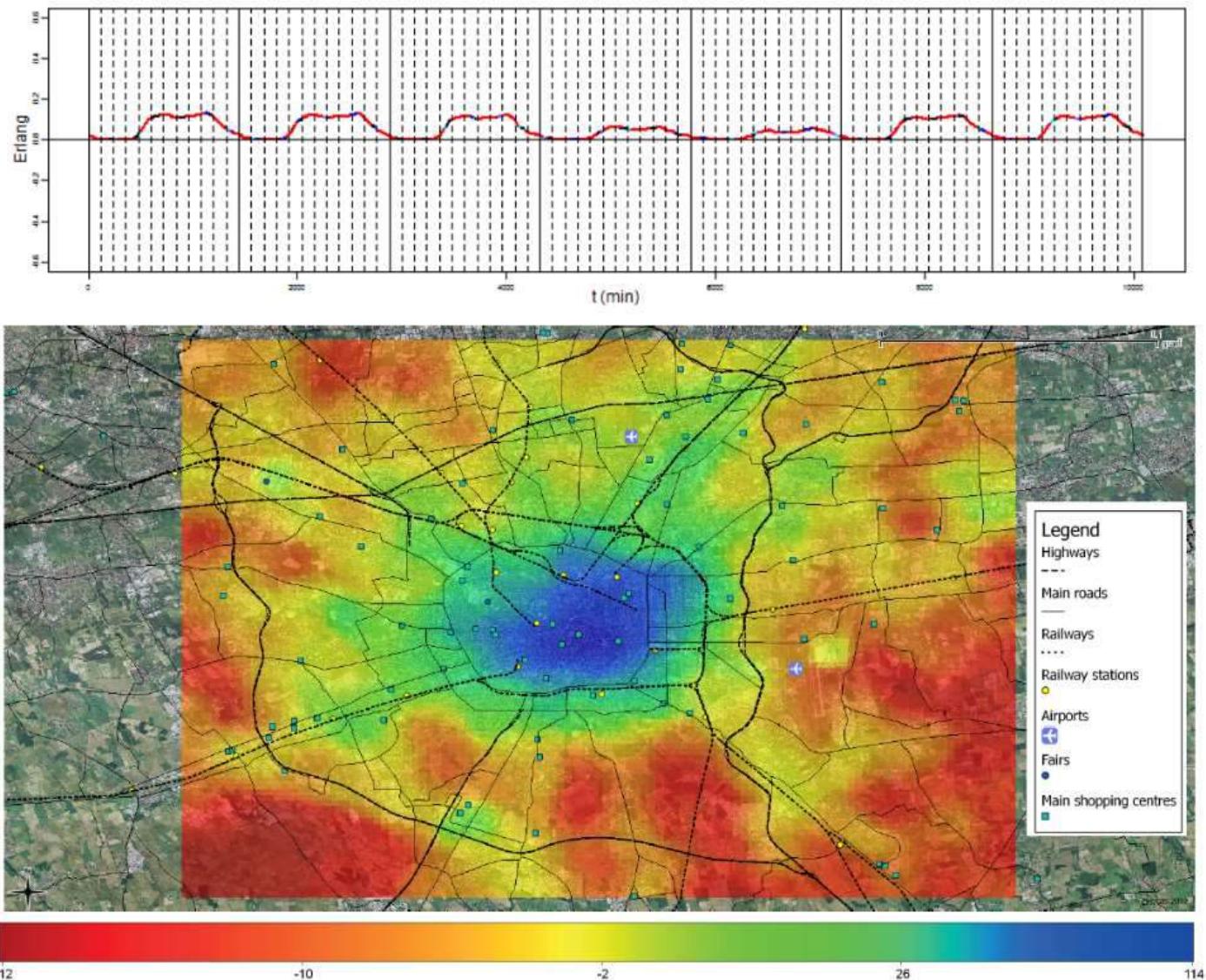
LAV_COND

numero di spostamenti effettuati per motivo lavoro con modo auto come conducente



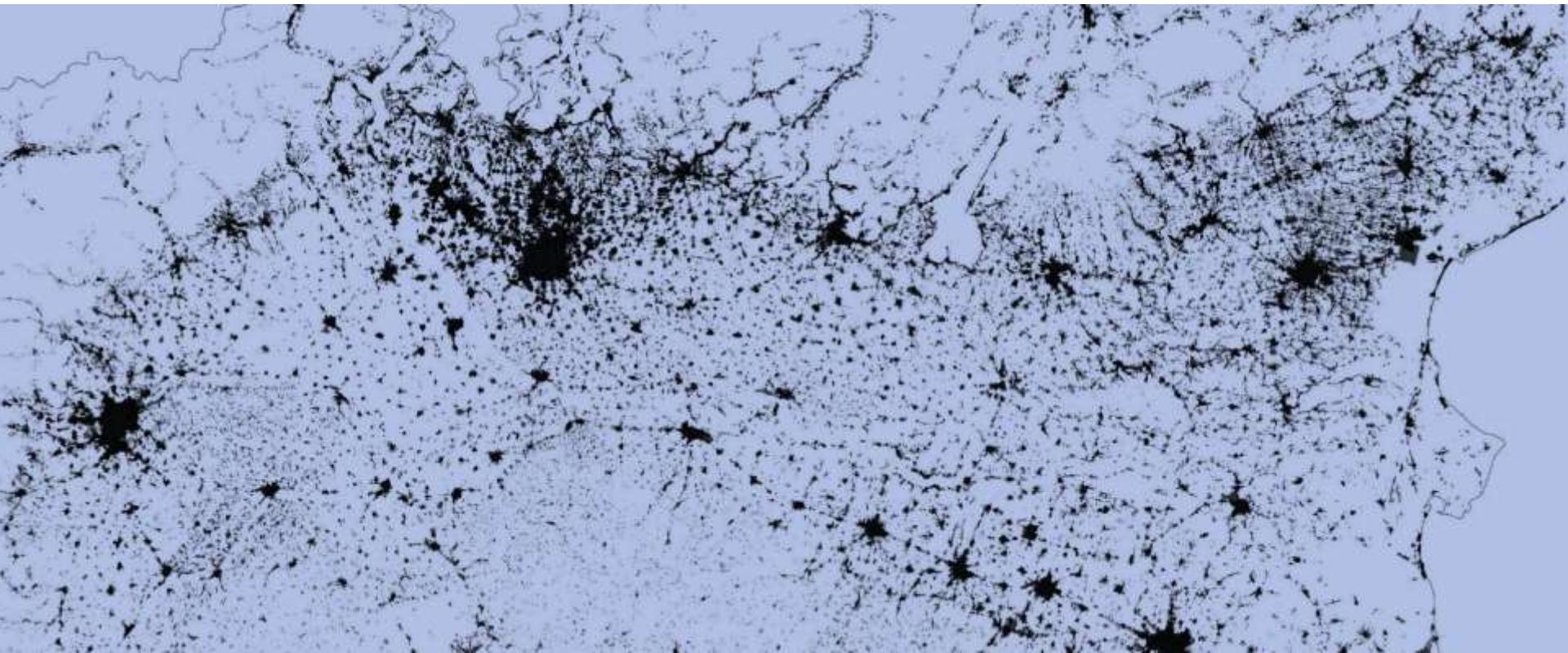
Source: Ferretti, 2015

Flow map



Source: Manfredini et al., 2013

Intensity map



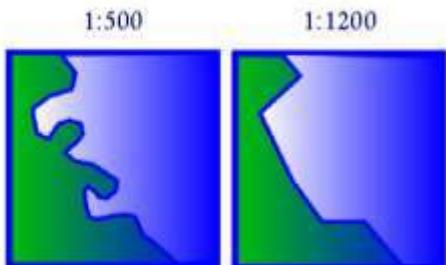
Source: Prin 2010

Thematic map: urbanization processes in Northern Italy

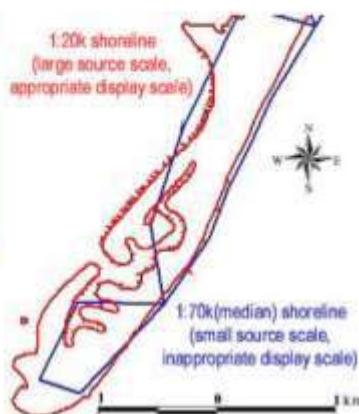
WHAT IS SCALE?

Scale is the scale represents the relationship of the distance on the map/data to the actual distance on the ground.

- Map detail is determined by the source scale of the data: the finer the scale, the more detail.
- Source scale is the scale of the data source (i.e. aerial photo or satellite image) from which data is digitized (into boundaries, roads, landcover, etc. in a GIS).
- In a GIS, zooming in on a small scale map does not increase its level of accuracy or detail.
- **Rule of thumb:** Match the appropriate scale to the level of detail required in the project.



Above, right. Comparing fine and coarse source scales shows how the level of detail in the data is determined by the spatial scale of the source data.

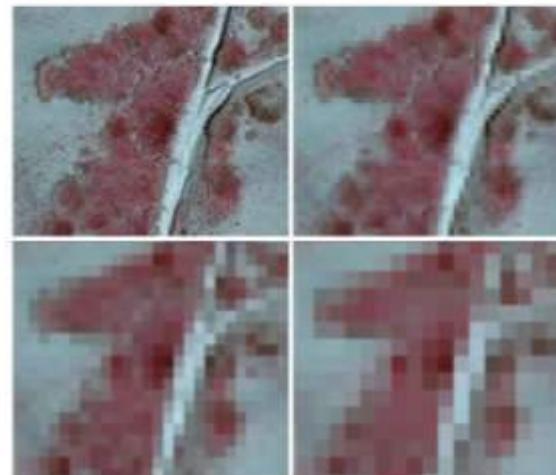


SPATIAL SCALE

Spatial scale involves *grain & extent*:

Grain: the size of your pixel & the smallest resolvable unit.

Extent: the size of your study area & the largest resolvable unit.



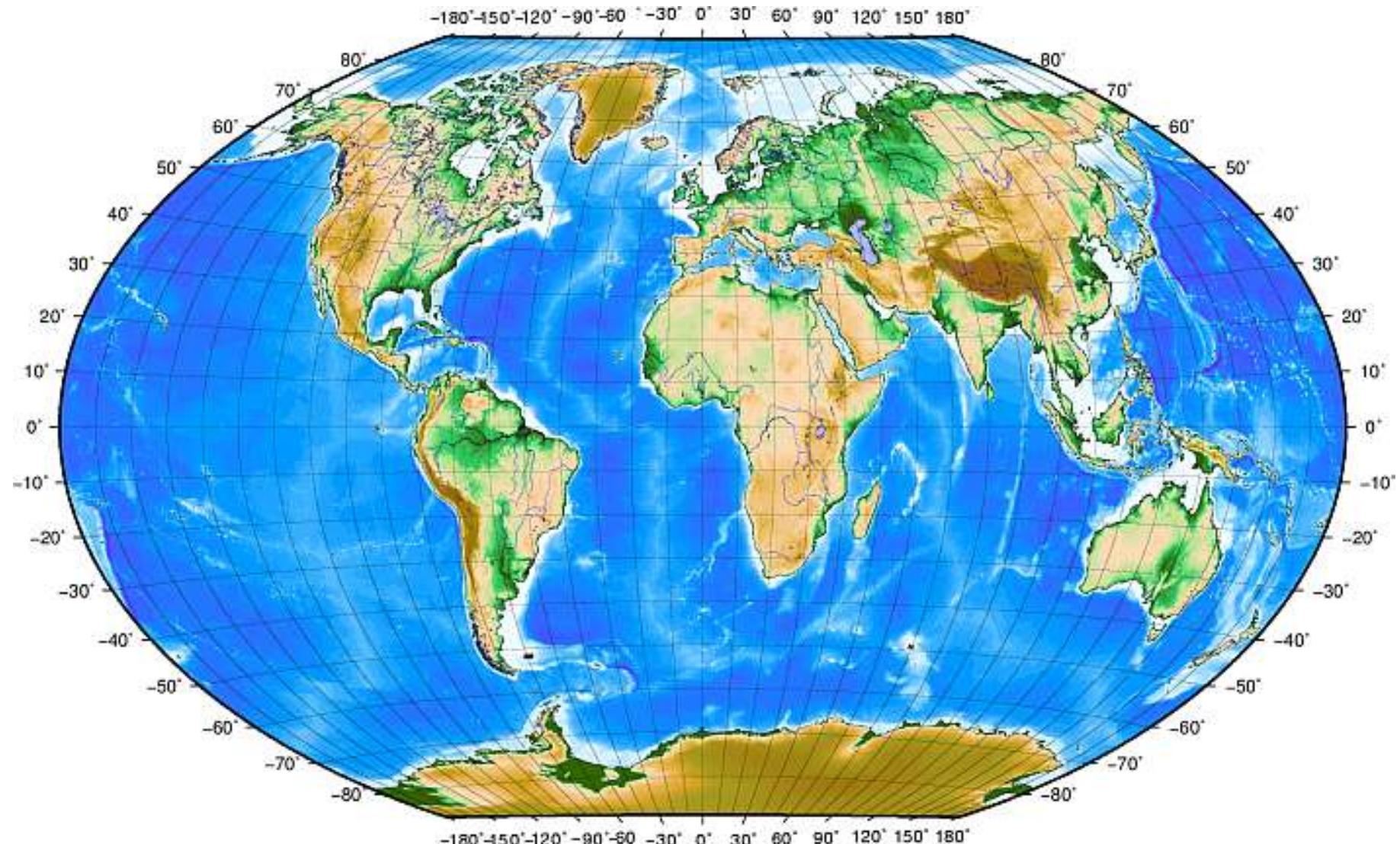
Left. This series of pictures shows a section of wetland at progressively bigger grain sizes.

The more detail the better; however, more detail requires more computer power.

You can also make grain size larger, but you can never make it smaller.

Common grain sizes:

- 30m – Landsat satellite imagery
- 30m, 10m – USGS quad digital elevation models (DEMs)
- 4m, 1m – IKONOS satellite imagery
- 1m – 2005 National Agricultural Imagery Program (NAIP) photos
- 8ft, 2ft – Quickbird satellite imagery
- 1ft – USGS 2004 color aerial photography



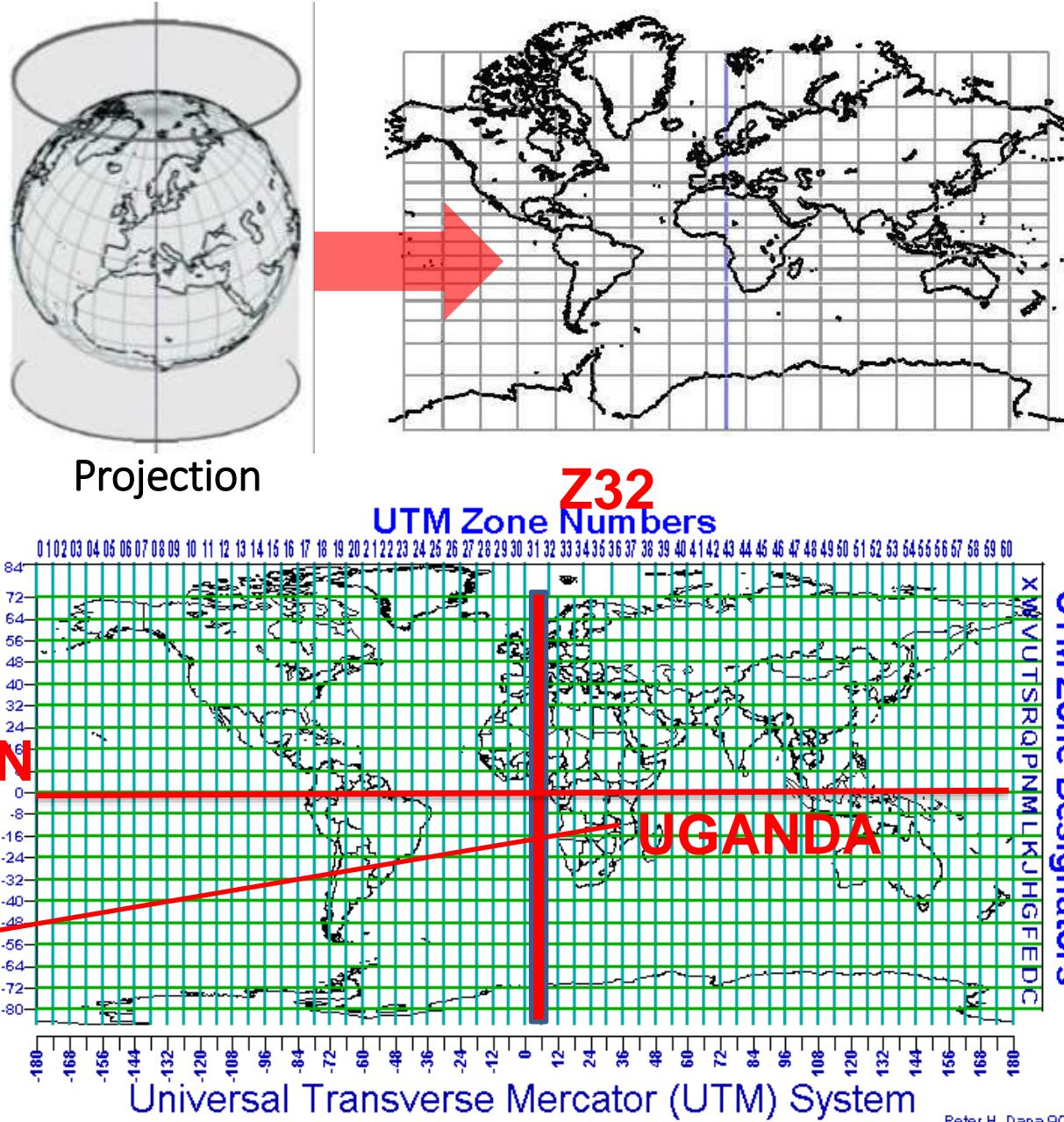
The use of Geographic Coordinate Reference Systems is very common. They use degrees of latitude and longitude and sometimes also a height value to describe a location on the earth's surface. The most popular is called **WGS 84**.

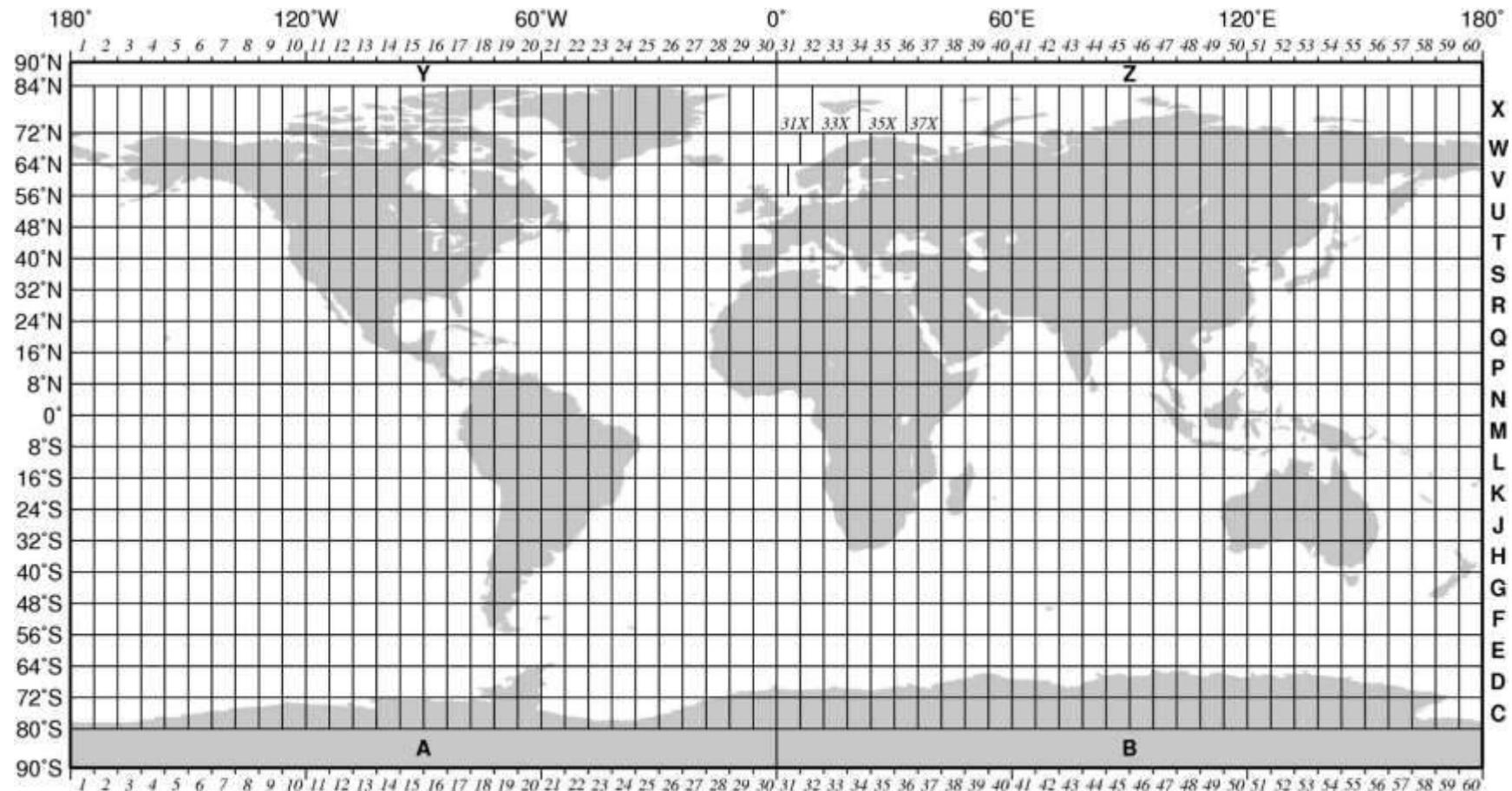
Universal Transverse Mercator (UTM)

The Universal Transverse Mercator (UTM) conformal projection uses a 2-dimensional Cartesian coordinate system. Like the traditional method of latitude and longitude, it is a horizontal position representation, i.e. it is used to identify locations on the Earth independently of vertical position.

The UTM system is not a single map projection. The system instead divides the Earth into sixty zones, each being a six-degree band of longitude, and uses a secant transverse Mercator projection in each zone.

Datum Projection
WGS 84/UTM zone 32N
(EPSG 32632)





The globe is divided into 60 zones between 84°S and 84°N , most of which are 6° wide. Each of these UTM zones have their unique central meridian. Furthermore, each zone is divided into latitude bands

Qgis: coordinate reference system

QGIS allows users to define a global and project-wide CRS (coordinate reference system) for layers without a pre-defined CRS. It also allows the user to define custom coordinate reference systems and supports on-the-fly (OTF) projection of vector and raster layers. All of these features allow the user to display layers with different CRSs and have them overlay properly.

QGIS has support for approximately 2,700 known CRSs. The CRSs available in QGIS are based on those defined by the European Petroleum Search Group (EPSG) and the Institut Géographique National de France (IGNF) and are largely abstracted from the spatial reference tables used in GDAL. EPSG identifiers are present in the database and can be used to specify a CRS in QGIS.

The EPSG Geodetic Parameter Dataset is a structured dataset of Coordinate Reference Systems and Coordinate Transformations, accessible through this online registry (www.epsg-registry.org) or, as a downloadable zip files, through IOGP's EPSG home page at www.epsg.org. The geographic coverage of the data is worldwide, but it is stressed that the dataset does not and cannot record all possible geodetic parameters in use around the world. The EPSG Geodetic Parameter Dataset is maintained by the Geodesy Subcommittee of IOGP's Geomatics Committee.

Geographic coordinate system

EPSG:4326 - WGS 84

Projected coordinate system

EPSG: 32636 WGS84/UTM zone 32N

EPSG: 3003 Monte Mario / Italy zone 1

EPSG: 3857 – WGS 84 / Pseudo Mercator

Used by certain Web mapping and visualization applications. Uses spherical development of ellipsoidal coordinates. Relative to an ellipsoidal development errors of up to 800 meters in position and 0.7 percent in scale may arise. It is not a recognized geodetic system

<http://spatialreference.org/>

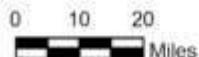
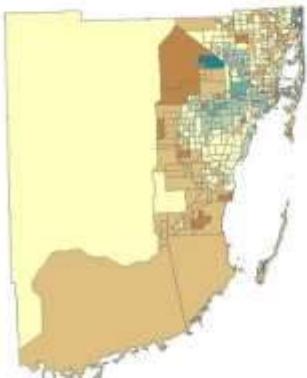
Related issue: data classification

Population Density of Seniors Living in Miami Dade County

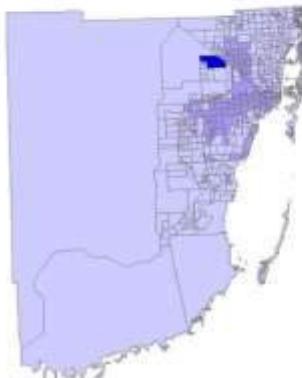
Percentage of Seniors Living Within Each Census Tract



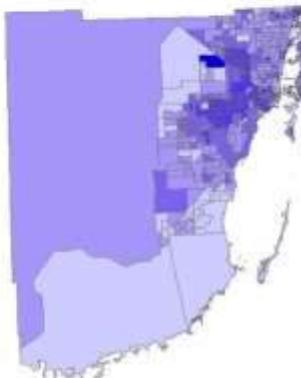
Standard Deviation



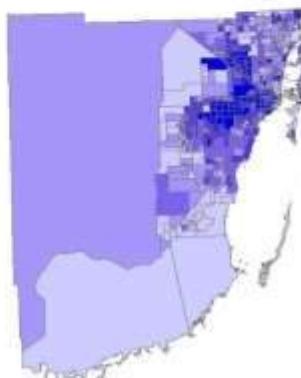
Equal Interval



Natural Breaks



Quantile



Produced by: Brad Husemann

Date: 2/17/2016

Data Source: US Census Bureau 2011

On line data sources

1. Internet diffusion

- Increase of velocity
- Increase of traffic volume
- Data archive
- Easy access to data, Easy sharing of data

2. Open Data initiative:

Open data is data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and sharealike.

- Governments
- Regions
- Public institutions, Agencies
- Municipalities
- Private sector (?)
- Etc.
- Spatial Open data (with coordinates or in geographic format)

On line data sources

Global Land Cover Facility.
<http://www.landcover.org/>



European Environmental Agency
<http://www.eea.europa.eu/data-and-maps>



Gisco - Geographic Information System of the European Commission
<http://ec.europa.eu/eurostat/web/gisco>



On line data sources: Italy

Il Portale Cartografico Nazionale
<http://www.pcn.minambiente.it/GN/>



ISTAT
<http://www.istat.it/it/>
Statistics and spatial dataset: urban blocks,
municipalities,....



Regione Lombardia.
<http://www.geoportale.regione.lombardia.it/>
Download spatial data, web services



Open data
<http://www.dati.gov.it/dataset>

Lombardia Geoportal

The screenshot shows the Lombardia Geoportal homepage. The main header reads "GEOPORTALE della Lombardia" with the subtitle "Dati, mappe, servizi geografici del territorio lombardo disponibili in rete". On the left, there's a sidebar menu with categories like "Informazioni", "Servizi", "Download Dati", "Documentazione", and "Link". The "Download Dati" section is highlighted. It contains a sub-section titled "Download Dati Geografici" with text explaining vector and raster data types. Below this is a "Servizio di Download Dati Geografici Vettoriali" form with dropdown menus for "Servizio" (set to "Servizio di Download Dati Geografici Vettoriali") and "Materie" (set to "CSD, CTR 1:100000, DTMs passo 20"). To the right, there are two vertical lists: "News" (with items like "28/03/10 - 24 maggio a Roma EPSG: riconcilia tecniche su DPMI sistemi geo...") and "Analisi Tematici" (with items like "Basi tematiche", "Basi di uso generale"). At the bottom, a footer note says "Sistema Informativo per la consultazione dell'Infrastruttura per l'Informazione Territoriale della Lombardia. Per l'utilizzo delle informazioni si prega di leggere le Note legali per l'utilizzo dei contenuti del Geoportale." and "Versione 1.1.3".

Lombardia Geoportal: direct download

The screenshot shows the "Servizio Download Dati Geografici" (Geographic Data Download Service) interface. On the left, there are two main sections: "Shape File" and "SELEZIONA". The "Shape File" section includes dropdown menus for "Formato dati" (set to "Shape File") and "Sistema di coordinate" (set to "Monte Mario Italy1"). The "SELEZIONA" section lists coordinate systems: "ED50/UTM zone 32N (Europa Metriche)", "Monte Mario Italy1", and "WGS84/UTM zone 32 N (Mondiali Metriche)". A red arrow points from the "Formato dati" dropdown to the "SELEZIONA" sidebar on the right. Another red arrow points from the "Sistema di coordinate" dropdown to the same sidebar. A third red arrow points from the "SELEZIONA" section at the bottom left to the "SELEZIONA" sidebar on the right. The right side of the interface features a large sidebar titled "SELEZIONA" which lists various geographic datasets. The sidebar is highlighted with a large red border.

SELEZIONA

- AGAPU Analisi e Governo Agricoltura Peri-Urbania
- Agriturismi
- Area agricola nello stato di fatto articolo43
- Aree a vincolo Idrogeologico ricognizione 2013
- Aree di Pregio Viti Vinicolo
- Aree dismesse
- Aree prioritarie per la biodiversità
- Aree Protette
- Bacini Idrografici 10000
- Banca dati Geologica di Sottosuolo
- Base Geografica Sintesi
- Basi Ambientali della Pianura
- BASI INFORMATIVE DEI SUOLI
- Beni Culturali
- Beni Culturali Vincolati
- Boschi da Seme
- Carta geologica 250000
- Carta Ittica Regionale
- Carta Tecnica Regionale 10000 vettoriale CT10
- Commercio
- Corine Land Cover
- Database Topografico Regionale - DBTR
- DATI GEOLOGICI OLTOREPO MANTOVANO
- Direttiva Alluvioni 2007/60/CE
- DUSAFA3 O USO SUOLO 2009
- Fontanili della Lombardia
- Geoambientale
- Geologia acqueferi - Gruppo A
- Ghiacciai
- Grandi Digue 10000
- GRIGLIE
- Impianti a fune
- Infrastrutture e Mobilità
- Inventario delle Frane e Disetti Idrogeologici Geof

RICERCA

ELENCO layer disponibili

- Area_idrica_corsi_diacqua_naturale_principale_1000
- Area_idrica_secondaria_10000_CT10
- Area_inculta_10000_CT10
- Area_in_trasformazione_10000_CT10
- Area_sterile_10000_CT10
- Area_stradale_e_autostradale_10000_CT10

ELENCO layer selezionati

- Area_agricola_10000_CT10

AREA DI INTERESSE

Tutta la regione Area personale

DESCRIZIONE AREA SELEZIONATA

INVIARE

SELEZIONA

- ED50/UTM zone 32N (Europa Metriche)
- Monte Mario Italy1
- WGS84/UTM zone 32 N (Mondiali Metriche)

FORMATO DATI

SISTEMA DI COORDINATE

INDIRIZZO E-MAIL

NOTA INFORMATIVA

Sistema informativo per la consultazione dell'infrastruttura per l'informazione territoriale della Lombardia. Per l'utilizzo delle informazioni si prega di leggere le [Note legali per l'utilizzo del contenuto del Geoportale](#).

Versione 1.3

Open Data

The screenshot shows the official website for OpenData Lombardia. At the top right, a red arrow points to the "OpenData Lombardia" logo. On the left, a sidebar lists categories: Argomenti (Tutti), e-government, m1, territorio (highlighted with a red arrow), trasparenza, and z1, with a "Vedi Tutti" link at the bottom.

The main content area features a banner with the text "gov = Government.new gov.open()" and an image of a smartphone. Below the banner are four cards: "Servizio Meteorologico Regionale", "Elenco degli Operatori Accreditati ai Servizi al Lavoro", "Prestazioni Ambulatoriali", and "Albo Regionale Imprese Boschive".

A search bar labeled "Cerca" is positioned above a table titled "Cerca e sfoglia dataset e visualizzazioni". The table includes columns for "Nome", "Tipi di viste", "Popolarità", and "Tipo". It lists several datasets such as "Elenco RSA-Accreditati", "Albo Cooperative Sociali", "Elenco Comunità Per Minori", "CEMID - Certificazione Energetica degli Edifici", "Contributi e Concessioni di Regione Lombardia", "Elenco degli Operatori accreditati ai Servizi da Formazione", "Elenco Regionale degli agriturismi", and "Elenco delle Associazioni di Promozione Sociale".

Lombardia Geoportal: wms

The screenshot shows the Lombardia Geoportal homepage. On the left, there is a sidebar with various links under categories like 'Informazioni', 'Servizi', and 'Documentazione'. A red box highlights the 'Tutti i Servizi' link. A red arrow points to the 'Servizi' section in the main content area, which lists 'Download Dati', 'Trasformazione di coordinate', 'Distribuzione Prodotti', and 'Servizi WMS'. Below this, there is a detailed description of the 'Acque di balneazione' service, news items, and a newsletter sign-up section.

iit
Infrastruttura
Informazione Territoriale

GEOPORTALE della Lombardia
Dati, mappe, servizi geografici del territorio lombardo disponibili in rete

Servizi

- Download Dati
- Trasformazione di coordinate
- Distribuzione Prodotti
- Servizi WMS

Tutti i Servizi

Documentazione

- Pianificazione per DB topografico
- Specifiche tecniche
- Metadati: manuale utente per le scelte...
- Normativa regionale di riferimento
- Geographic database: descrizione...
- Tutta la documentazione

Link

- Agenzia per l'Italia Digitale
- SESTO INFORMATIVO TERRITORIALE RISOS...
- CNRIS Cartografia geologica - Viterbo...
- Tutti i Link

In Poco Piano

Acque di balneazione

Pubblicato il 16 luglio il collegamento al portale "Acque di balneazione" del Ministero della Salute dal quale è possibile consultare la mappa delle balneabilità delle spiagge di tutta l'Italia.

Per controllare quella della Lombardia basta inserire il nome del Comune nel campo Cerca della mappa: una volta aperta la mappa si vedono in verde le aree balneabili. Dal simbolo a sfondo blu, che indica il punto di controllo - si accede al grafico con i risultati delle analisi fatte dalle ASL. La Direzione generale Salute ha realizzato la sezione anagrafica e cartografica del portale per quanto riguarda la Lombardia.

News

- 24/06/14 - Bande di gara: Applicazione multimediali nelle trasformazioni...
- 13/06/14 - Attivato il servizio di mappa con i Percorsi Ciclistici di L...
- 03/06/14 - Limbi amministrativi 2014

Tutte le news

Inserimento alla NewsLetter

Per essere aggiornato sulle novità del Geoportal iscriviti alla NewsLetter.

Sistema informatico per la consultazione dell'Infrastruttura per l'Informazione Territoriale della Lombardia.
Per l'utilizzo delle informazioni si prega di leggere le Note finali per l'utilizzo dei contenuti del Geoportal.

Versone 1.0

Lombardia Geoportal: wms

The screenshot shows the Lombardia Geoportal interface. On the left, there is a sidebar with various menu items such as 'Stato DII Topografico', 'Download Dati', 'Trasformazione di coordinate', 'Tutti i Servizi', 'Dizionario', 'Procedimenti per DII Topografico', 'Specifiche tecniche', 'Materiali: inesclusi clienti per le norme...', 'Normativa regionale DI', 'Riferimenti', 'Geografico: identificativi descrittivi', 'Tutte le documentazioni', 'Link', 'Agente per l'Italia Digitale', 'SISTEMA INFORMATIVO TERRITORIALE RAGEL...', 'CARIS (Catalogo delle geofiche italiane...)', and 'Tutti i servizi'. A red arrow points to the first item in the list, 'Ortofoto AGEA 2012'. The main content area displays five service entries:

- Ortofoto AGEA 2012**
Type: Mappe (Servizi di mappa)
Description: Le ortofoto a colori pubblicate sono state acquisite con velivolo da Agape (Agenzia per le erogazioni in agricoltura,...).
Ente/Società: Direzione Generale Territorio, urbanistica e difesa del suolo, Regione Lombardia
[Apri Mappa](#) [Dettagli](#)
- PLT - Tavole delle Previsioni di Piano - WMS**
Type: Mappe (Servizi di mappa)
Description: Tavole delle Previsioni di Piano dei Piani di Governo del Territorio - P.G.T. - redatti dai Comuni, visualizzate...
Ente/Società: Direzione Generale Territorio e Urbanistica, Regione Lombardia
[Apri Mappa](#) [Dettagli](#)
- DTM20 - Servizio di Mappa WMS - Modello Digitale del Terreno**
Type: Mappe (Servizi di mappa)
Description: Il modello digitale del terreno è rappresentato da un DTM con struttura a griglia con passo di campionamento pari a 20 metri, che può essere utilizzato sia per analizzare l'andamento omografico del territorio lombardo(...).
Ente/Società: Direzione Generale Territorio, urbanistica e difese del suolo, Regione Lombardia
[Apri Mappa](#) [Dettagli](#)
- Mappa Risca - Servizio di Mappa WMS**
Type: Mappe (Servizi di mappa)
Description: Servizio WMS mappa risca della Lombardia.
Ente/Società: Direzione Generale Territorio e Urbanistica, Unità Organizzativa Infrastrutture per l'Informazione Territoriale, Regione Lombardia
[Apri Mappa](#) [Dettagli](#)
- DUSAF 2.1 - Uso suolo 2007 - Servizio di mappa WMS**
Type: Mappe (Servizi di mappa)
Description: Servizio di mappa WMS contenente l'uso del suolo del progetto DUSAF aggiornato omogeneamente all'anno 2007.
Ente/Società: Direzione Generale Territorio e Urbanistica, Regione Lombardia
[Apri Mappa](#) [Dettagli](#)
- Mappa politica - Servizio di Mappa WMS**
Type: Mappe (Servizi di mappa)
Description: Servizio di mappa WMS della mappa politica della Lombardia.
Ente/Società: Direzione Generale Territorio e Urbanistica, Regione Lombardia
[Apri Mappa](#) [Dettagli](#)

Lombardia Geoportal: wms services

Lombardia
Servizi
Ricerca nel Catalogo
Basi geografiche e cartografiche
Catalogo
Stato DB Topografico
Download dati
Trasformazione di coordinate
Tutti i Servizi

Documentazione
Finanziamenti per DB topografico
Specifiche tecniche
Metadati: manuale utente per la stampa...
Normativa regionale di riferimento
Geographic database description card...
Tutta la documentazione

Link
Agenzia per l'Italia Digitale
SISTEMA INFORMATIVO TERRITORIALE RISI...
CARTO Cartografia geologica...
Tutti i Link

Dati identificativi del prodotto

Titolo: Orthofoto ADEA 2012
Tipo: Mappa (Servizi di mappa)
Ente/Società: Direzione Generale Territorio, Urbanistica e difesa dei suoli, Regione Lombardia
Data pubblicazione: 15/07/2013

Informazioni generali sul prodotto

Formato di pubblicazione: Mappa digitale
Descrizione: Le ortofoto a colori pubblicate sono state acquisite con voli aerei da Agipa (Agenzia per le ampliazioni in agricoltura) nel 2012 nell'ambito delle attività di gestione e controllo del SIAN (Sistema Informativo Agricolo Nazionale).
Ambiti tematici ISO: Contatti amministrativi e politici, Immagini/Mappa di base/Copertura del suolo
Parole chiave: ortofoto, ADEA, SIC, nMIS, immagine, Servizio di accesso a mappe

Riferimenti per informazioni

Punto di contatto: Regione Lombardia
Direzione Generale Territorio, Urbanistica e difesa dei suoli
E-Mail: Sis_Ru@regione.lombardia.it
Telefono: 02-67651

Informazioni sui dati territoriali

Tipo di dati: Dati raster
Frequenza di aggiornamento: I dati sono aggiornati quando ritenuto necessario
Sistema di riferimento: wgs84/utm-32n
Coordinate spaziali utente

Ovest	Sud	Est	Nord	Unità di misura
462.135.997	4.813.434.278	1.003.282.865	5.327.950.68	Metri

Coordinate spaziali (GCS)

Ovest	Sud	Est	Nord	Unità di misura
7.686	43.305	15.738	48.125	Gradi Decimali

Informazioni su distribuzione, limitazioni d'uso e accessibilità

Formato di distribuzione: Web Map Service
Versione: WMS 1.1.1
Ente distributore: Regione Lombardia
Distribuzione: Direzione Generale Territorio, Urbanistica e difesa dei suoli
Descrizione distribuzione: Le copie dei dati sono disponibili solo per gli Enti pubblici e le Società regionali. Ha va fatta richiesta - senza oneri aggiuntivi - inviando una mail dalla propria PEC (Posta Elettronica Certificata) all'indirizzo PEC delle seguenti Province, con cui la Regione Lombardia ha sottoscritto un accordo di distribuzione: - Bergamo [protecc0ff@pec.provincia.bergamo.it]; - Cremona [protecc0ff@pec.provincia.cremona.it]; - Lucca [provincia.lucca@pec.legaaffari.comcon.it]; - Lodi [provincia.lodi@pec.regione.lombardia.it]; - Mantova [provincia.mantova@pecmantova.it]; - Monza e Brianza [protecc0ff@pec.provincia.mi.it]; - Novara [protecc0ff@pec.provincia.novara.it]; - Sondrio [protecc0ff@certi.provincia.sondrio.it]; - Varese [protecc0ff@pec.provincia.varese.it]. Per le Province che non hanno aderito al protocollo di distribuzione, la richiesta va inviata al seguente indirizzo di Regione Lombardia: termine0ff@pec.regione.lombardia.it. Per caricare questo servizio

segueva indicare url: http://www.cartografia.regione.lombardia.it/ArcGIS10.0/services/area/Orthofoto2012_uow/StacServer/WMTSServer?version=1.1.1

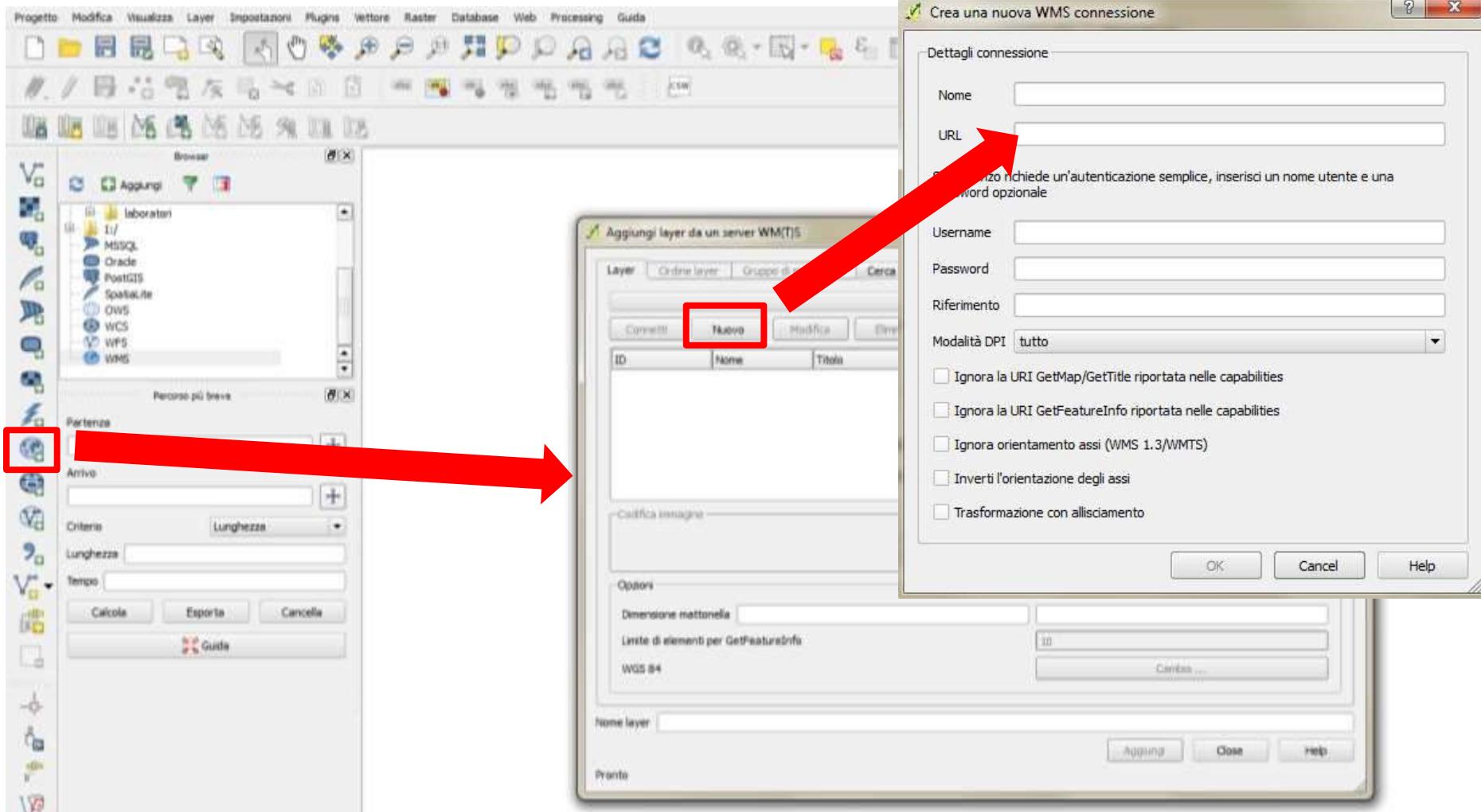
Limitazioni di accesso:
Limitazioni d'uso:
Uso pubblico
Copyright

Informazioni sulla qualità

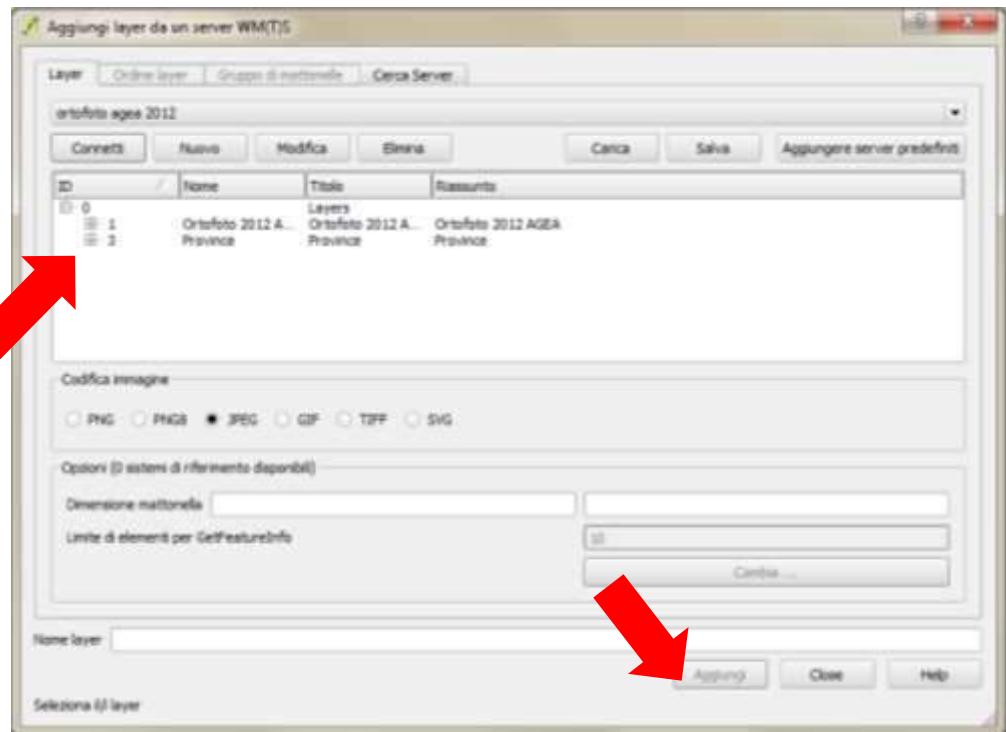
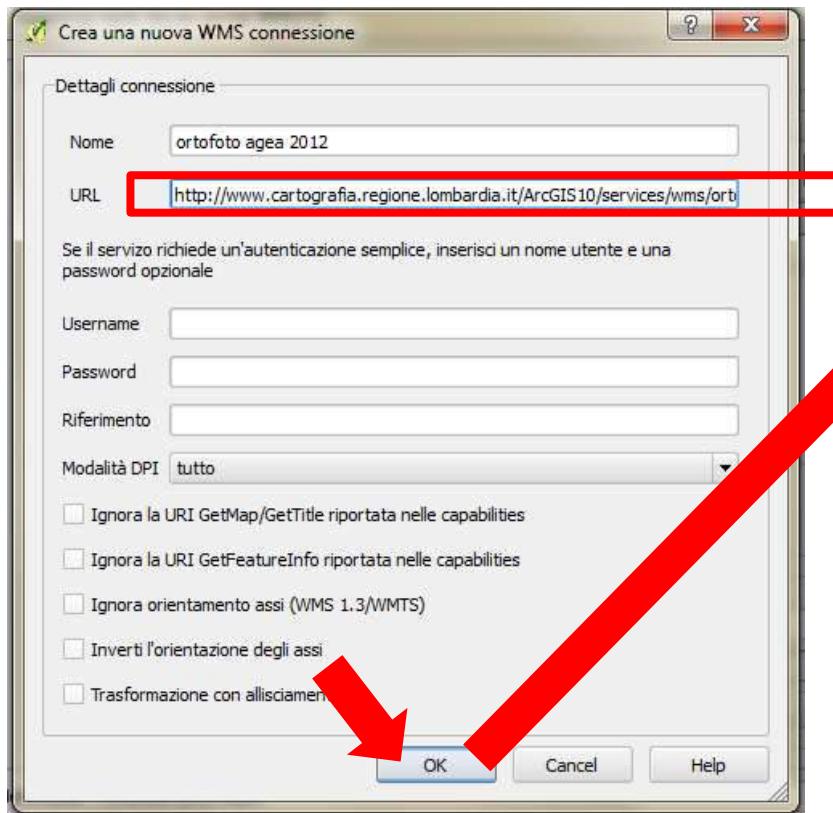
Modalità di realizzazione del prodotto: Le immagini, in UTM32N-wGS84, a pixel 20 cm, sono state acquisite con voli aerei da Agipa (Agenzia per le ampliazioni in agricoltura) e resse disponibili alla Regione.



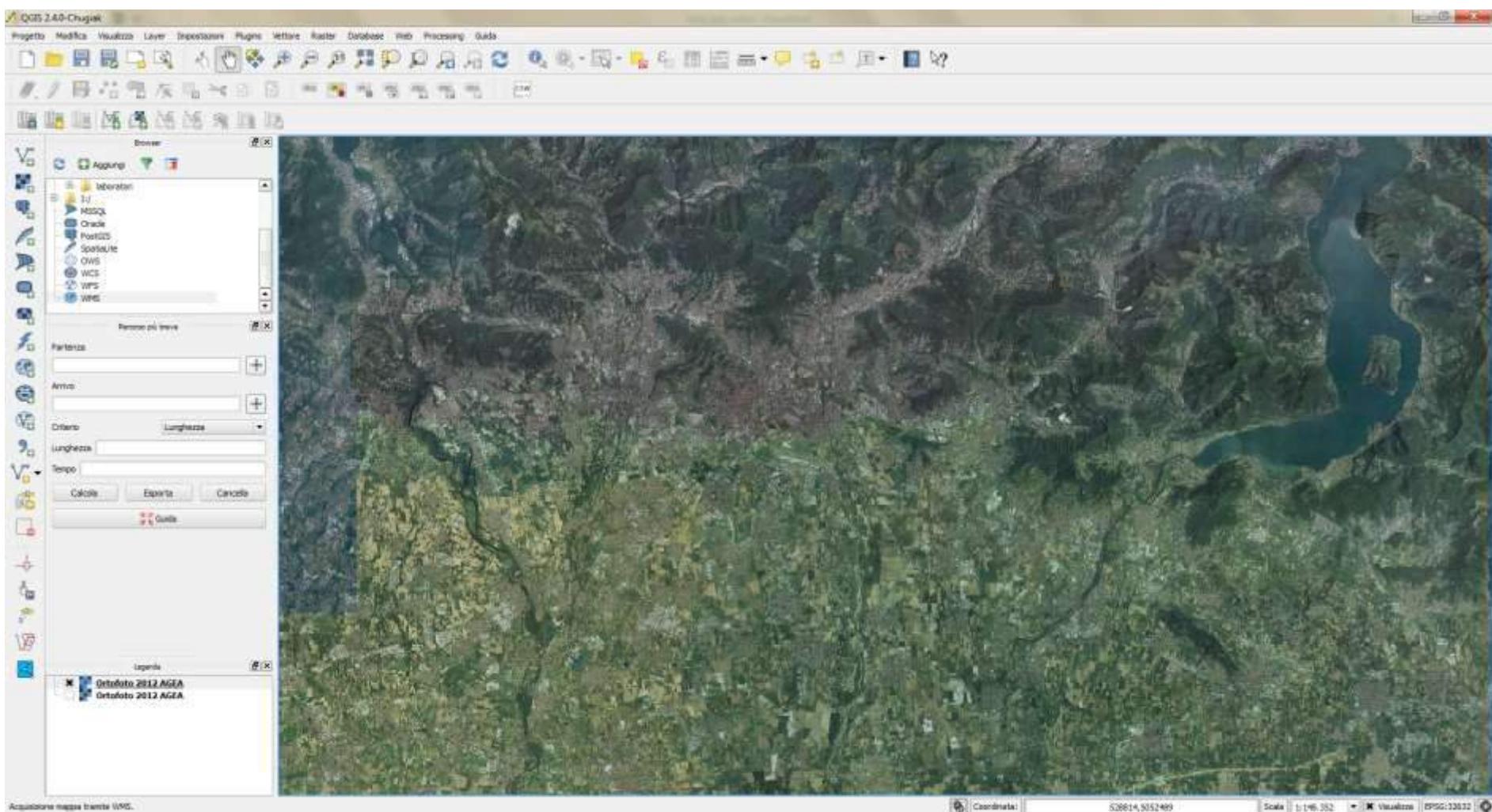
QGIS: WMS layer import



QGIS: WMS layer import



QGIS: WMS layer import



OpenStreetMap

OpenStreetMap is the largest open geographic database in the world, the data infrastructure for multitudes of mapping projects around the globe. Launched in 2004, OpenStreetMap works in an editable style similar to Wikipedia (3 million users)

Open Database Licence (ODbL)

OpenStreetMap is a community.

OpenStreetMap is open data: you are free to use it for any purpose as long as you credit OpenStreetMap and **its contributors**.



ODC Open Database License (ODbL) Summary

This is a human-readable summary of the [ODbL 1.0 license](#). Please see the disclaimer below.

You are free:



To Share: To copy, distribute and use the database.



To Create: To produce works from the database.



To Adapt: To modify, transform and build upon the database.

As long as you:



Attribute: You must attribute any public use of the database, or works produced from the database, in the manner specified in the ODbL. For any use or redistribution of the database, or works produced from it, you must make clear to others the license of the database and keep intact any notices on the original database.



Share-Alike: If you publicly use any adapted version of this database, or works produced from an adapted database, you must also offer that adapted database under the ODbL.



Keep open: If you redistribute the database, or an adapted version of it, then you may use technological measures that restrict the work (such as DRM) as long as you also redistribute a version without such measures.

MORE INFORMATION

- [Introduction to Open Data](#)
- [Open Definition for Data](#)
- [Quick guide to making data open](#)
- [Open Data Handbook](#)

OpenStreetMap's conceptual data model

Elements are the basic components of OpenStreetMap's *conceptual data model of the physical world*. They consist of

- **nodes** (defining points in space);
- **ways** (defining linear features and area boundaries);
- **relations** (which are used to explain how other elements work together).
- All of the above can have one or more associated **tags** (which describe the meaning of a particular element).



(a) Node

A drinking fountain as a single pair of coordinates.
lat: 40.7303993,
lon: -73.9970100,
version: 1,
tags: {
 amenity:
 drinking_water,
 name:
 Washington
 Square}



(b) Way: Path

A series of 41 nodes which create this footway
id: 197582876,
changeset: 31859815,
uid: 1306,
version: 2,
timestamp: 2015-06-10T03:06:09Z,
tags: {
 highway: footway}



(c) Way: Building

Series of 4 nodes that outline the arch
id: 248166269,
tags: {
 building: yes,
 height: 20.5,
 name:
 Washington
 Square Arch
 tourism:
 attraction}



(d) Relation: Path

A collection of 3 ways creating a footway
members: [
 {way: archId},
 {way: poolId},
 {way: parkId}
]
tags: {
 highway:
 pedestrian}

OpenStreetMap for urban studies

- «Reliable» and «updated»
- Easy to add in GIS and in webapp
- Global coverage:
- Many uses:
 - background (openlayer, basemap)
 - Feature extraction (overpass turbo - <http://overpass-turbo.eu/>) or in Qgis
 - Available extracts for cities (Metro-extract <https://mapzen.com/data/metro-extracts/>), countries (<http://download.geofabrik.de/>), etc..
- Starting point for complex elaborations: accessibility, indicators,
- Complex articulation of features (*key, value*)
- Useful for classrooms
- Research results
- Potential for public administrations
-

OSM / Google Maps comparison:

<http://tools.geofabrik.de/mc/#18/45.4785/9.2260?num=3&mt0=mapnik&mt1=google-satellite&mt2=google-map>

The screenshot displays the 'Map Compare' tool interface from Geofabrik. It features three panels side-by-side, each showing a different map type of the same area in Milan, Italy.

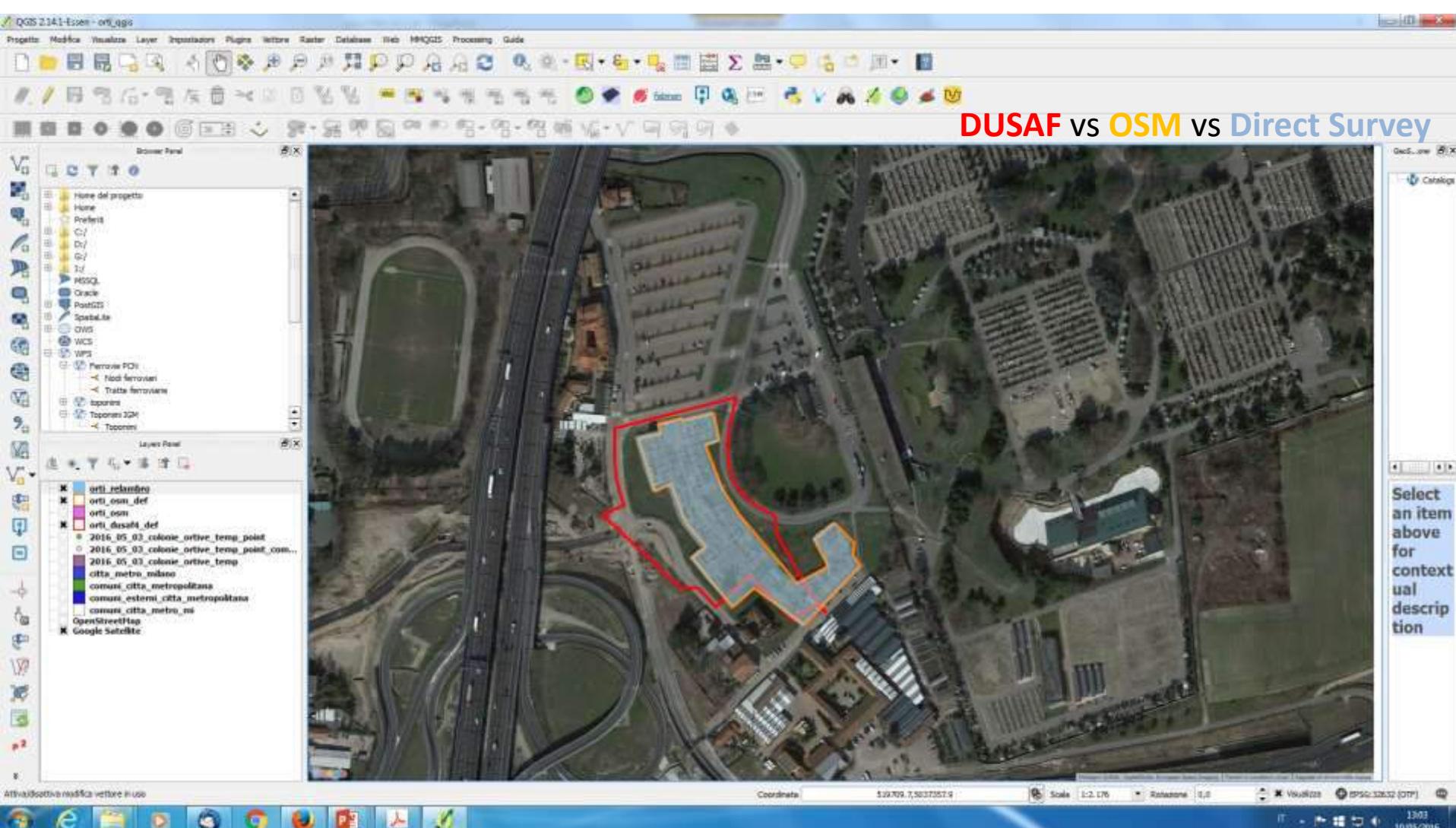
- Left Panel (OSM Carto):** Shows a detailed OpenStreetMap (OSM) rendering. It includes street names like "Via Leonardo da Vinci", "Piazza Leonardo da Vinci", and "Via Benedetto Spinoza". Landmarks such as the "Scuola Leonardo da Vinci" and "Istituto Comprensivo" are visible. A green shaded area represents a park or sports field. A scale bar at the bottom left indicates distances from 20m to 100m.
- Middle Panel (Google Satellite):** Displays an aerial photograph of the same area, providing a visual reference for the OSM data. It shows buildings, roads, and green spaces from a bird's-eye view.
- Right Panel (Google Map):** Shows a standard Google Map view of the area. It includes labels for "Politecnico di Milano", "Albergo Leonardo da Vinci", "Book Store Città Universitaria", and "Città Universitaria".

The top navigation bar includes links for "File", "Modifica", "Visualizza", "Chronologia", "Segnalibri", "Strumenti", and "Aiuto". The address bar shows the URL of the current page. The top right corner has a "Help" button and a "Switch tool..." link. The overall title of the window is "Map Compare | Geofabrik Tools".

All maps except Bing/Google/HERE based on OSM data © OpenStreetMap (License: ODbL 1.0), OSM Tiles licensed CC-BY-SA 2.0 - [help](#) - [contact](#) - [fullscreen](#)

R^ A ^ d 18/07
06/03/2018

DUSAf vs OSM vs Direct Survey



OpenStreetMap features

OpenStreetMap represents physical [features](#) on the ground (e.g., roads or buildings) using [tags](#) attached to its basic data structures (its [nodes](#), [ways](#), and [relations](#)). Each tag describes a geographic attribute of the feature being shown by that specific node, way or relation.

OpenStreetMap's [free tagging system](#) allows the map to include an unlimited number of attributes describing each feature. The community agrees on certain key and value combinations for the most commonly used tags, which act as informal standards. However, users can create new tags to improve the style of the map or to support analyses that rely on previously unmapped attributes of the features. Short descriptions of tags that relate to particular topics or interests can be found using the [feature pages](#).

Getting high quality data is essential for any GIS task. One great resource for free and openly licensed data is [OpenStreetMap\(OSM\)](#). The **OSM database** consists of streets, local data as well as building polygons. Getting access to OSM data in a GIS format is integrated in QGIS.

• 1 Primary features

- [1.1 Aerialway](#)
- [1.2 Aeroway](#)
- [1.3 Amenity](#)
 - [1.3.1 Sustenance](#)
 - [1.3.2 Education](#)
 - [1.3.3 Transportation](#)
 - [1.3.4 Financial](#)
 - [1.3.5 Healthcare](#)
 - [1.3.6 Entertainment, Arts & Culture](#)
 - [1.3.7 Others](#)
- [1.4 Barrier](#)
 - [1.4.1 Linear Barriers](#)
 - [1.4.2 Access Control on Highways](#)
- [1.5 Boundary](#)
 - [1.5.1 Attributes](#)
- [1.6 Building](#)
 - [1.6.1 Accommodation](#)
 - [1.6.2 Commercial](#)
 - [1.6.3 Civic/Amenity](#)
 - [1.6.4 Other Buildings](#)
 - [1.6.5 Additional Attributes](#)
- [1.7 Contact](#)
- [1.8 Craft](#)
- [1.9 Emergency](#)
- [1.10 Geological](#)
- [1.11 Highway](#)
 - [1.11.1 Roads](#)
 - [1.11.2 Link roads](#)
 - [1.11.3 Special road types](#)
 - [1.11.4 Paths](#)
 - [1.11.5 Lifecycle](#)
 - [1.11.6 Attributes](#)
 - [1.11.7 Other highway features](#)
- [1.12 Historic](#)

• 1.13 Landuse

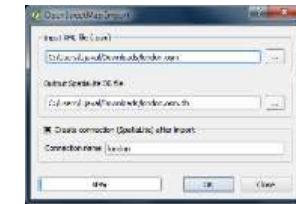
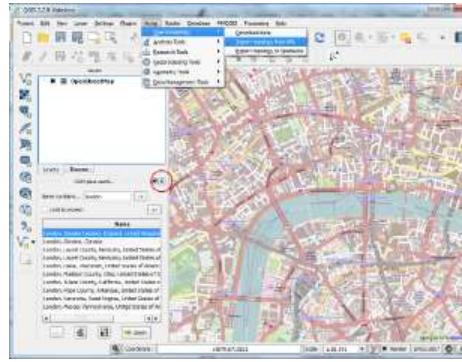
- [1.14 Leisure](#)
- [1.15 Man Made](#)
- [1.16 Military](#)
- [1.17 Natural](#)
 - [1.17.1 Vegetation or surface related](#)
 - [1.17.2 Water related](#)
 - [1.17.3 Landform related](#)
- [1.18 Office](#)
- [1.19 Places](#)
 - [1.19.1 Administratively declared places](#)
 - [1.19.2 Populated settlements, urban](#)
 - [1.19.3 Populated settlements, urban and rural](#)
 - [1.19.4 Other places](#)
 - [1.19.5 Additional attributes](#)
- [1.20 Power](#)
- [1.21 Public Transport](#)
- [1.22 Railway](#)
 - [1.22.1 Tracks](#)
 - [1.22.2 Additional features](#)
 - [1.22.3 Stations and Stops](#)
 - [1.22.4 Other railways](#)
- [1.23 Route](#)
- [1.24 Shop](#)
 - [1.24.1 Food, beverages](#)
 - [1.24.2 General store, department store, mall](#)
 - [1.24.3 Clothing, shoes, accessories](#)
 - [1.24.4 Discount store, charity](#)
 - [1.24.5 Health and beauty](#)
 - [1.24.6 Do-it-yourself, household,](#)

building materials, gardening

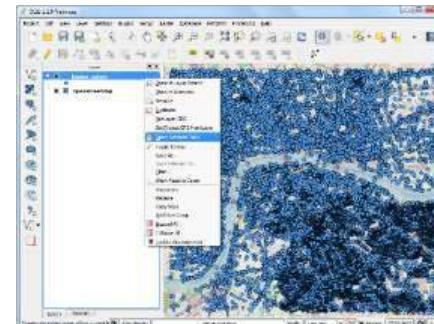
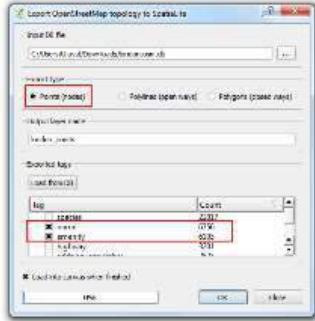
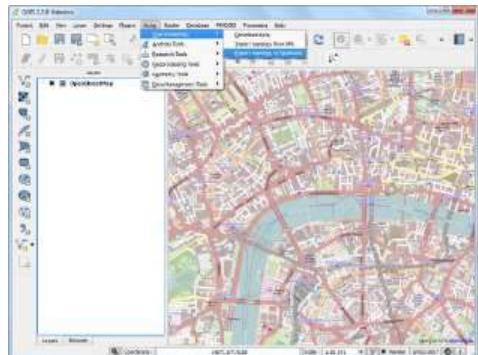
- [1.24.7 Furniture and interior](#)
- [1.24.8 Electronics](#)
- [1.24.9 Outdoors and sport, vehicles](#)
- [1.24.10 Art, music, hobbies](#)
- [1.24.11 Stationery, gifts, books, newspapers](#)
- [1.24.12 Others](#)
- [1.25 Sport](#)
- [1.26 Tourism](#)
- [1.27 Traffic calming](#)
- [1.28 Waterway](#)
 - [1.28.1 Natural watercourses](#)
 - [1.28.2 Man made waterways](#)
 - [1.28.3 Facilities](#)
 - [1.28.4 Barriers on waterways](#)
 - [1.28.5 Other features on waterways](#)
 - [1.28.6 Some additional attributes for waterways](#)
- [2 Additional properties](#)
- [2.1 Addresses](#)
 - [2.1.1 Tags for individual houses](#)
 - [2.1.2 For countries using hamlet, subdistrict, district, province, state](#)
 - [2.1.3 Tags for interpolation ways](#)
- [2.2 Annotation](#)
- [2.3 Name](#)
- [2.4 Properties](#)
- [2.5 References](#)
- [2.6 Restrictions](#)
- [2.7 Surface](#)
- [2.8 Smoothness](#)

QGIS: import OSM data

1. Download OSM data from map canvas
2. Import topology from XML file (*.osm)



3. Export topology to spatialite (portable spatial db)
4. Load exported tags from db into map canvas



OSM: overpass-turbo

wiki.openstreetmap.org/wiki/Tag:highway%3Dmotorway

Più visitati Come iniziare Raccolta Web Slice Siti suggeriti Save to Mendeley

Viki Pagina Discussione Leggi Visualizza sorgenti Cronologia Ricerca

Tag:highway=motorway

Available languages: Deutsch English español français 한국어 Italiano Nederlands 日本語 polski português português do Brasil русский українська Other languages — Help us translating this wiki

The tag `highway=motorway` is used to identify the highest-performance roads within a territory. Typically, these controlled-access highways have a minimum of two lanes in each direction that are separated by a barrier. Motorways are commonly referred to as a **freeway** in American and Australian English. Non-motorised traffic is banned from using these roads in most territories, with some exceptions, for example rural motorways in western U.S.

For roads that do not meet the above requirements consider using `highway=trunk`. See [Highway:International equivalence](#) for guidance on the use of motorway in different countries.

Use [highway=motorway_link](#) for shorter link roads (sliproads/ramps) leading to and from a motorway.

Indice [nascondi]

- 1 Implied values
- 2 How to map
- 3 International equivalence
- 4 Quality tool

Implied values

While the box on the right lists some implied tags, they have been changed several times, they are often country-specific and the community does not agree about the implications. Please tag them anyways to clear out any doubt.

How to map

A motorway is normally represented by a series two parallel ways, one for each carriageway tagged with `highway=motorway`. These ways should all point direction of travel and be tagged with `oneway=yes`. In the less usual case of a motorway where traffic travels in both directions along the same carriageway use a single way and tag it with `oneway=no`. When drawing parallel ways, place the nodes for each direction next to each other, which results in a better representation on most maps. The following tags may be applicable:

Tagging scheme for <code>highway=motorway</code>		
Tag	Description	Example
<code>name=*</code>	Name of the motorway.	Autostraada del Fion
<code>ref=*</code>	Reference name.	A3
<code>oneway=yes</code>	See section #How to map	
<code>lanes=*</code>	Number of lanes.	3
<code>maxspeed=*</code>	The maximum speed which is allowed (in km/h).	130
<code>minspeed=*</code>	Minimum speed which a vehicle must be capable of to use the motorway (in km/h).	50
<code>destination=*</code>	Name of town for the direction of the motorway. Normally the town written on the sign which belongs to the motorway-limit.	Frankfurt
<code>carriageway_ref=*</code>	In the UK, the reference number for the carriageway as displayed on Highway Agency signing.	B

Consider adding the all of these ways to a relation of type (what type of relation? Peterlto 02:47, 20 January 2013 (UTC))

highway = motorway

Description: High capacity highways designed to safely carry fast motor traffic.

Group: Highway

Used on these elements:

Useful combination:

- `name=*`
- `ref=*`
- `oneway=yes`
- `lanes=*`
- `destination=*`

Implies:

- `access=no`
- `motor_vehicle=yes`
- `oneway=yes`
- `surface=paved`

Status: Approved

Taginfo [More...]

<input checked="" type="checkbox"/> 8 0.00 %
<input checked="" type="checkbox"/> 597 767 0.72 %
<input checked="" type="checkbox"/> 85 0.56 %

Tools for this tag

- [taginfo](#) [trig](#) [check](#) [is](#) [us](#)
- [overpass-turbo](#)

Siti suggeriti Save to Mendeley

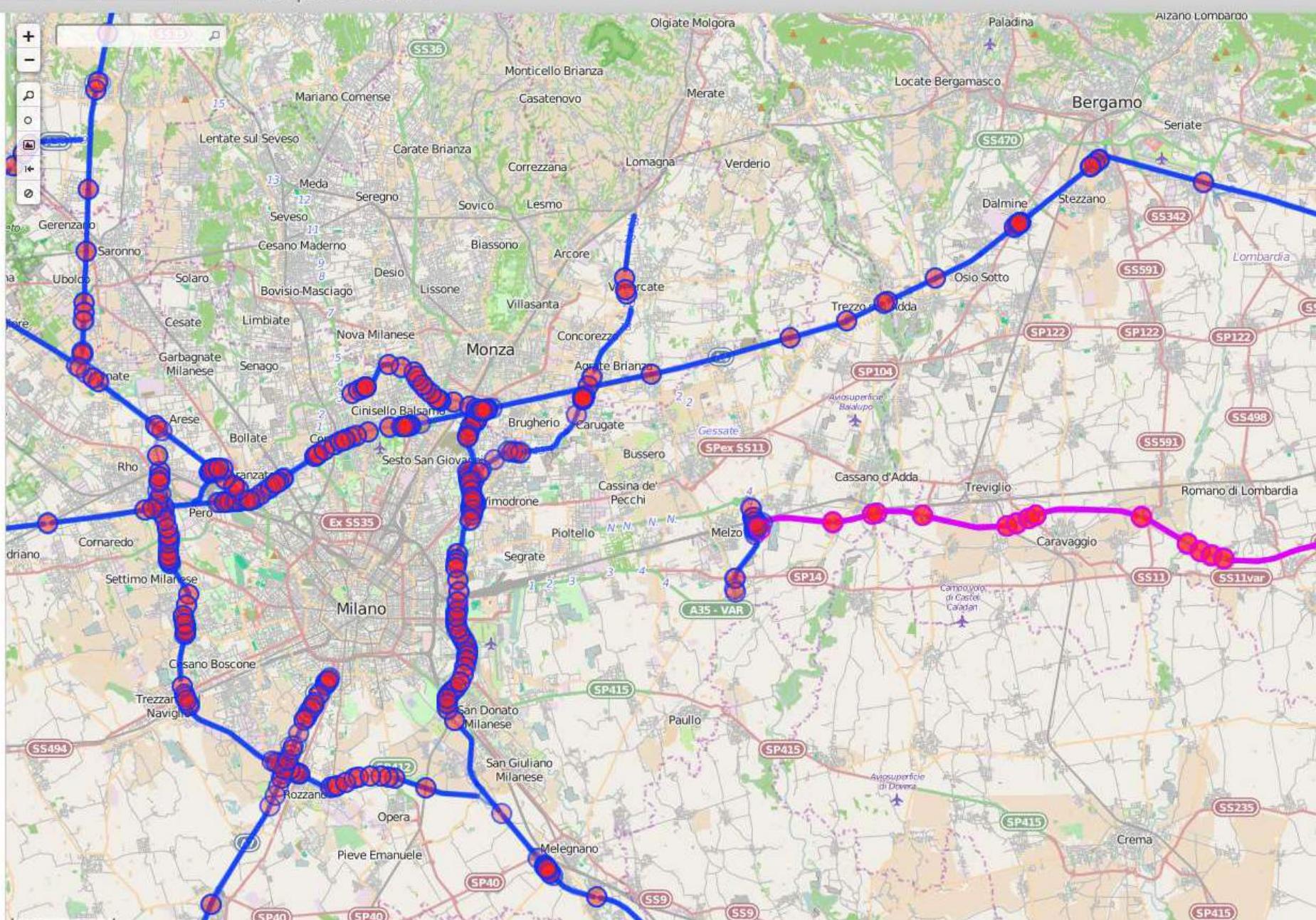
Salva

Carica

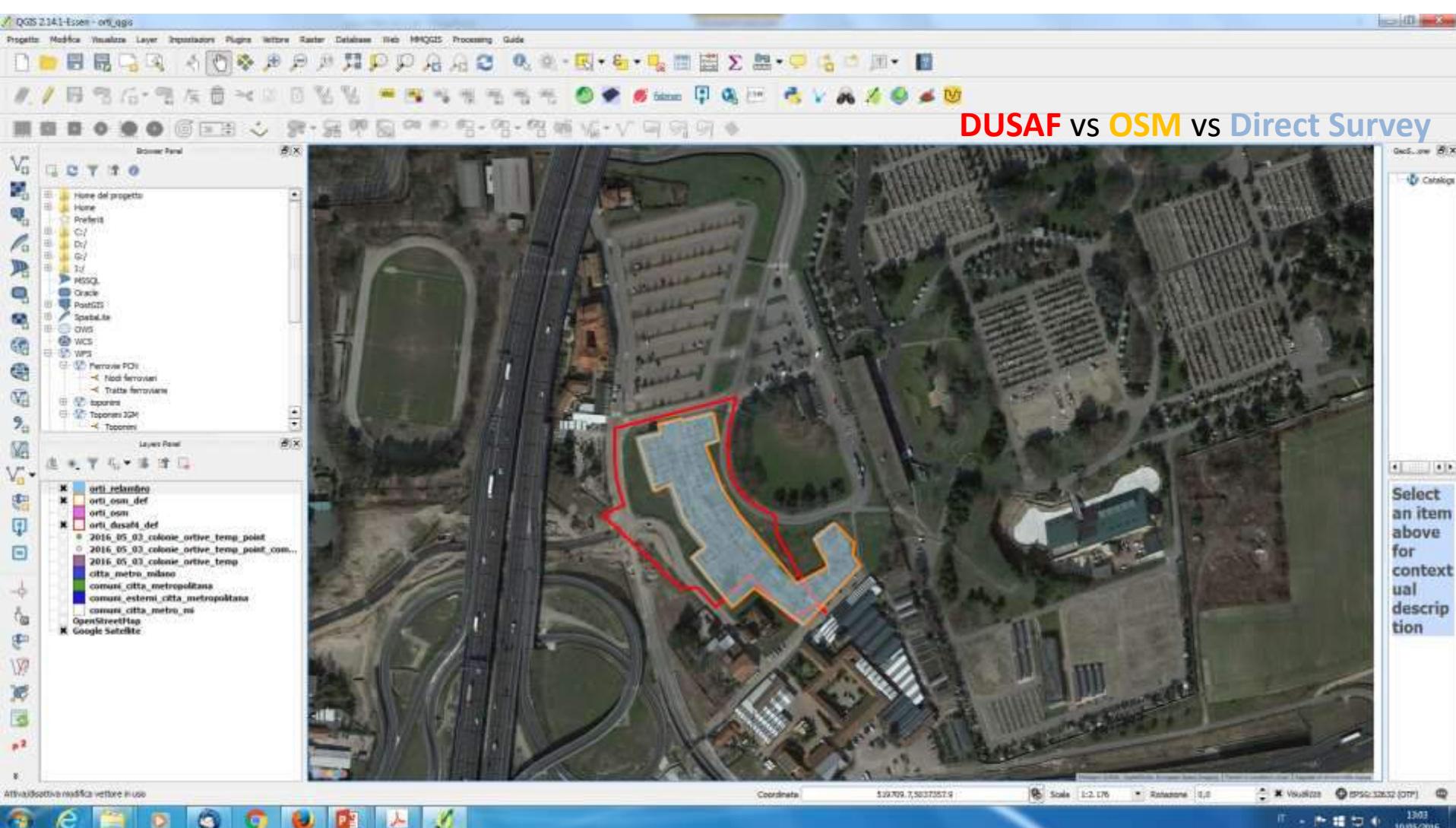
Impostazioni

Aiuto

overpass turbo



DUSAf vs OSM vs Direct Survey



References

- Goodchild, M.F. 2007. Citizens as sensors: the world of volunteered geography. *GeoJournal*, 69 (4), 211-221.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W. 2001. *Geographic information system and Science*. Oxford: John Wiley & Sons, Ltd.
- Pucci, P., Manfredini, F., & Tagliolato, P. (2015). *Mapping urban practices through mobile phone data*. Heidelberg, New York, Dordrecht, London: Springer.

<http://www.for-rent.polimi.it/mappature/>

<http://giscommons.org/introduction-concepts/>

<http://www.qgis.org/it/site/>

<http://www.qgistutorials.com/en/>

<http://colorbrewer2.org/#type=sequential&scheme=BuGn&n=3>

<http://metrocosm.com/mercator/>

<https://www.openstreetmap.org/#map=5/51.500/-0.100>